

project manual:

college of nursing fifth floor west renovation

university of utah health sciences

university of utah project number: 588-11498

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SECTION 01732 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, University of Utah Boiler Plate, and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of a building or structure.
 - 2. Repair procedures for selective demolition operations.
- B. Related Sections include the following:
 - 1. Division 15 Sections for demolishing, cutting, patching, or relocating mechanical items.
 - 2. Division 16 Sections for demolishing, cutting, patching, or relocating electrical items.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Interruption of utility services.
 - 2. Coordination for shutoff, capping, and continuation of utility services.
 - 3. Use of elevator and stairs.
 - 4. Locations of temporary partitions and means of egress.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- B. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.

1.7 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than **72** hours' notice to Owner of activities that will affect Owner's operations.
- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
 - 1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- C. Owner assumes no responsibility for condition of areas to be selectively demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.

2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site will not be permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.

- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
 - 1. Provide at least **72** hours' notice to Owner if shutdown of service is required during changeover.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - 1. **Owner** will arrange to shut off indicated utilities when requested by Contractor.
 - 2. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
 - 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
- D. Utility Requirements: Refer to Division 15 and 16 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

- A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 - 2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - 3. Protect existing site improvements, appurtenances, and landscaping to remain.
- C. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- D. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
- E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- F. Temporary Shoring: Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

- A. Dust Control: Use temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
 2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 8. Dispose of demolished items and materials promptly.
 9. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- B. Existing Facilities: Comply with Owner requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

C. Removed and Salvaged Items: Comply with the following:

1. Clean salvaged items.
2. Store items in a secure area until delivery to Owner.
3. Transport items to Owner's storage area **designated by Owner**.
4. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items: Comply with the following:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition **and cleaned** and reinstalled in their original locations after selective demolition operations are complete.

F. Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 7 Section for new roofing requirements.

3.6 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

C. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

D. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- E. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION 01732

SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior standing and running trim.
 - 2. Wood cabinets.
 - 3. Plastic-laminate cabinets.
 - 4. Solid-surfacing-material countertops.
 - 5. Flush wood paneling and wainscots.
 - 6. Shop finishing interior woodwork.
- B. Related Sections include the following:
 - 1. Division 8 Section "Flush Wood Doors."

1.3 DEFINITIONS

- A. Interior architectural woodwork includes furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

- A. Product Data: For counter **material(s), fire-retardant-treated materials, cabinet hardware and accessories, and finishing materials and processes.**
 - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of cutouts and holes for **plumbing fixtures, faucets, and other items** installed in architectural woodwork.
 - 3. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

- C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.
 - 1. Shop-applied transparent finishes.
 - 2. Solid-surfacing materials.
- D. Samples for Verification: For the following:
 - 1. Lumber with or for transparent finish, **50 sq. in.**, for each species and cut, finished on 1 side and 1 edge.
 - 2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
 - 3. Wood-veneer-faced panel products with or for transparent finish, **8 by 10 inches**, for each species and cut. Include at least one face-veneer seam and finish as specified.
 - 4. Solid-surfacing materials, **6 inches (150 mm)** square.
 - 5. Plastic Laminate materials.
 - 6. Exposed cabinet hardware and accessories, one unit for each type.
- E. Product Certificates: Signed by manufacturers of woodwork certifying that products furnished comply with requirements.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.
 - 1. Provide AWI Quality Certification Program **certificate** indicating that woodwork complies with requirements of grades specified.
- D. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or,

where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

- E. Mockups: Before fabricating and installing interior architectural woodwork, build mockups for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be **installed**.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Architect's approval of mockups before starting interior architectural woodwork fabrication.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood for Transparent Finish: Species: Cherry, Cut: Match Architect's Sample.
- C. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade **MD-Exterior Glue**.
 - 3. Hardwood Plywood and Face Veneers: HPVA HP-1.
- D. Thermoset Decorative Overlay: Particleboard complying with ANSI A208.1, Grade M-2, or medium-density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
 - a. Formica Corporation.
 - b. Wilsonart International; Div. of Premark International, Inc.
- F. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Corian; DuPont Polymers.

2.2 FIRE-RETARDANT-TREATED MATERIALS (Required at Reception Area/Lobby)

- A. General: Where indicated, use materials impregnated with fire-retardant chemical formulations indicated by a pressure process or other means acceptable to authorities having jurisdiction to produce products with fire-test-response characteristics specified.

1. Do not use treated material that does not comply with requirements of referenced woodworking standard or that is warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with AWPA C20 (lumber) and AWPA C27 (plywood), for woodwork items indicated as fire-retardant treated. Use the following treatment type:
1. Exterior Type: Organic-resin-based formulation thermally set in wood by kiln-drying.
 2. Interior Type A: Low-hygroscopic formulation.
 3. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
 4. Kiln-dry material before and after treatment to levels required for untreated material.
- C. Fire-Retardant-Treated Lumber and Plywood by Nonpressure Process: Apply nontoxic, water-soluble, fire-retardant treatment by dip, spray, roller, curtain coating, vacuum chamber, or soaking to achieve flame-spread rating of **25** or less and smoke-developed rating of 450 or less per ASTM E 84.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, **135** degrees of opening.
- D. Back-Mounted Pulls: BHMA A156.9, B02011.
- E. Wire Pulls: Back mounted, **5 inches** long, **2-1/2 inches** deep, and **5/16 inches** in diameter.
- F. Catches: **Magnetic catches**, BHMA A156.9, B03141.
- G. Adjustable Shelf Standards and Supports: **BHMA A156.9, B04071; with metal shelf rests, B04081.**
- H. Shelf Rests: BHMA A156.9, B04013.
- I. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:
1. Box Drawer Slides: **100 lbf (440 N).**
 2. File Drawer Slides: **200 lbf (890 N).**
 3. Pencil Drawer Slides: **45 lbf (200 N).**

- J. Door Locks: BHMA A156.11, E07121, BHMA A156.11, E07041.
- K. Grommets for Cable Passage through Countertops: **1-1/4-inch (32-mm)** OD, **black**, molded-plastic grommets and matching plastic caps with slot for wire passage.
- L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
- M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Furring, Blocking, Shims, and Hanging Strips at reception area/lobby: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.5 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide **Premium** grade interior woodwork complying with the referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: **1/16 inch**.
- E. Complete fabrication, including assembly, **finishing**, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check

measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

- F. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

- 1. Seal edges of openings in countertops with a coat of varnish.

2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 300.
- B. Grade: **Premium.**
- C. For rails wider or thicker than available lumber, use veneered construction. Do not glue for width or thickness.
- D. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- E. Wood Species and Cut: Species: Cherry, Cut: Match Architect's Sample.

2.7 WOOD CABINETS FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 400 requirements for wood cabinets.
- B. Grade: **Premium.**
- C. AWI Type of Cabinet Construction: **As indicated.**
- D. Reveal Dimension: **1/2 inch (13 mm).**
- E. Wood Species and Cut for Exposed Surfaces: Species: Cherry, Cut: Match Architect's Sample.
 - 1. Grain Matching: **Run and match grain vertically for drawer fronts, doors, and fixed panels.**
 - 2. Matching of Veneer Leaves: **Random** match.
 - 3. Veneer Matching within Panel Face: **Balance** match.
 - 4. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.
- F. Semiexposed Surfaces: Provide surface materials indicated below:
 - 1. Surfaces Other Than Drawer Bodies: **Thermoset decorative overlay**
 - 2. Drawer Sides and Backs: **Thermoset decorative overlay.**
 - 3. Drawer Bottoms: **Thermoset decorative overlay.**

2.8 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for high-pressure decorative laminate countertops.
- B. Quality Standard: Comply with WIC Section 16.
- C. Grade: **Premium**.
- D. High-Pressure Decorative Laminate Grade: **HGP**.
- E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. Provide Architect's selections from manufacturer's full range of colors and finishes in the following categories:
 - a. Patterns.
- F. Edge Treatment: **As indicated**.
- G. Core Material: **Medium-density fiberboard** and at sink location **Medium-density fiberboard made with exterior glue**.

2.9 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for countertops.
- B. Grade: **Premium**.
- C. Solid-Surfacing-Material Thickness: **3/4 inch (19 mm)**.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
 - 1. Match Architect's sample.
- E. Fabricate tops in one piece with shop-applied backsplashes and edges, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

2.10 FLUSH WOOD PANELING AND WAINSCOTS

- A. Quality Standard: Comply with AWI Section 500 requirements for flush wood paneling.
- B. Grade: **Premium**.
- C. Wood Species and Cut: Species: Cherry, Cut: Match Architect's Sample.
 - 1. Lumber Trim and Edges: At fabricator's option, trim and edges indicated as solid wood (except moldings) may be either lumber or veneered construction compatible with grain and color of veneered panels.

- D. Matching of Adjacent Veneer Leaves: **Random** match.
- E. Vertical Matching of Adjacent Veneer Leaves: End match.
- F. Veneer Matching within Panel Face: **Balance** match.
- G. Panel-Matching Method: Match panels within each separate area by the following method:
 - 1. Sequence-matched, uniform-size sets.
- H. Vertical Panel-Matching Method: **Continuous** match.
- I. Fire-Retardant-Treated Paneling: Provide panels consisting of wood veneer and fire-retardant particleboard or fire-retardant medium-density fiberboard. Panels shall have flame-spread rating of **25** or less and smoke-developed rating of 450 or less per ASTM E 84.

2.11 SHOP FINISHING

- A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative overlay.
- D. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523:
 - 1. Grade: **Premium**.
 - 2. AWI Finish System TR-4: Conversion varnish.
 - 3. Staining: **Match Architect's sample**.
 - 4. Wash Coat for Stained Finish: Apply a vinyl wash coat to woodwork made from closed-grain wood before staining and finishing.
 - 5. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
 - a. Apply vinyl wash coat sealer after staining and before filling.
 - 6. Sheen: **Satin, 30-50** gloss units.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.
- B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of **1/8 inch in 96 inches**.
- C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with recommendations of chemical treatment manufacturer, including those for adhesives used to install woodwork.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails **or finishing screws** for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than **60 inches** long, except where shorter single-length pieces are necessary. **Scarf running joints and stagger in adjacent and related members.**
 - 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.
 - 2. Install wall railings on indicated metal brackets securely fastened to wall framing.
 - 3. Install standing and running trim with no more variation from a straight line than **1/8 inch in 96 inches (3 mm in 2400 mm)**.
- G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than **1/8 inch in 96-inch** sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.
 - 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than **16 inches** o.c. with **No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips, No. 10 wafer-head sheet metal screws through**

metal backing or metal framing behind wall finish, or toggle bolts through metal backing or metal framing behind wall finish. Meet requirements for Seismic Zone 3.

- H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than **1/8 inch in 96-inch** sag, bow, or other variation from a straight line.
 - 3. Secure backsplashes **to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.**
 - 4. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
- I. Paneling: Anchor paneling to supporting substrate with **concealed panel-hanger clips**. Do not use face fastening, unless **otherwise indicated**.
 - 1. Install flush paneling with no more than **1/16 inch in 96-inch** vertical cup or bow and **1/8 inch in 96-inch** horizontal variation from a true plane.
- J. Complete the finishing work specified in this Section to extent not completed at shop or before installation of woodwork. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in shop.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06402

SECTION 07811 - SPRAYED FIRE-RESISTIVE MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Concealed sprayed fire-resistive materials.
 - 2. Topcoats.
 - 3. Sealers.
- B. Related Sections include the following:
 - 1. Division 7 Section "Through-Penetration Firestop Systems" for fire-resistance-rated firestopping systems.
 - 2. Division 9 Section "**Gypsum Board Assemblies**" for gypsum-board-based fire protection.

1.3 DEFINITIONS

- A. Concealed Sprayed Fire-Resistive Materials: Applied to surfaces that are concealed from view behind other construction when the Work is completed.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Certificates: For each type of sprayed fire-resistive material, signed by product manufacturer.
- C. Qualification Data: For **installer**, manufacturer and testing agency.
- D. Compatibility and Adhesion Test Reports: From sprayed fire-resistive material manufacturer indicating the following:
 - 1. Materials have been tested for bond with substrates.
 - 2. Materials have been verified by sprayed fire-resistive material manufacturer to be compatible with substrate primers and coatings.

3. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for proposed sprayed fire-resistive materials.
- F. Research/Evaluation Reports: For sprayed fire-resistive materials.
- G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its sprayed fire-resistive materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- C. Source Limitations: Obtain sprayed fire-resistive materials through one source from a single manufacturer.
- D. Sprayed Fire-Resistive Materials Testing: By a qualified testing and inspecting agency engaged by Contractor or manufacturer to test for compliance with specified requirements for performance and test methods.
 1. Sprayed fire-resistive materials are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 2. Testing is performed on specimens of sprayed fire-resistive materials that comply with laboratory testing requirements specified in Part 2 and are otherwise identical to installed fire-resistive materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.
 3. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.
- E. Compatibility and Adhesion Testing: Engage a qualified testing and inspecting agency to test for compliance with requirements for specified performance and test methods.

1. Test for bond per ASTM E 736 and requirements in UL's "Fire Resistance Directory" for coating materials. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 2. Verify that manufacturer, through its own laboratory testing or field experience, has not found primers or coatings to be incompatible with sprayed fire-resistive material.
- F. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify bags containing sprayed fire-resistive materials with appropriate markings of applicable testing and inspecting agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency acceptable to authorities having jurisdiction, for sprayed fire-resistive material serving as direct-applied protection tested per ASTM E 119.
 2. Surface-Burning Characteristics: ASTM E 84.
- G. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life if applicable, and fire-resistance ratings applicable to Project.
- B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.
- C. Store materials inside, under cover, aboveground, and kept dry until ready for use. Remove from Project site and discard wet or deteriorated materials.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply sprayed fire-resistive material when ambient or substrate temperature is 40 deg F (4 deg C) or lower unless temporary protection and heat is provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of sprayed fire-resistive material. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.8 COORDINATION

- A. Sequence and coordinate application of sprayed fire-resistive materials with other related work specified in other Sections to comply with the following requirements:
1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
 2. Provide temporary enclosures for applications to prevent deterioration of fire-resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
 3. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
 4. Do not apply fire-resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.
 5. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
 6. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
 7. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by Contractor and by Installer, in which manufacturer agrees to repair or replace sprayed fire-resistive materials that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
1. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of sprayed fire-resistive materials from substrates.
 2. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.
- B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

- A. General: For concealed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated for material composition and physical properties representative of installed products.
- B. Products:
 - 1. Cementitious Sprayed Fire-Resistive Material:
 - a. Grace, W. R. & Co.--Conn., Construction Products Div.; Monokote Type MK-6/HY, or pre approved equal compatible with existing substrate.
- C. Material Composition: **As follows:**
 - 1. Cementitious sprayed fire-resistive material consisting of factory-mixed, dry formulation of gypsum or portland cement binders and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.
- D. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:
 - 1. Dry Density: 15 lb/cu. ft. (240 kg/cu. m) for average and individual densities regardless of density indicated in referenced fire-resistance design, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWC Technical Manual 12-A, Section 5.4.5, "Displacement Method."
 - 2. Thickness: Provide minimum average thickness required for fire-resistance design indicated according to the following criteria, but not less than 0.375 inch (9 mm), per ASTM E 605:
 - a. Where the referenced fire-resistance design lists a thickness of 1 inch (25 mm) or greater, the minimum allowable individual thickness of sprayed fire-resistive material is the design thickness minus 0.25 inch (6 mm).
 - b. Where the referenced fire-resistance design lists a thickness of less than 1 inch (25 mm) but more than 0.375 inch (9 mm), the minimum allowable individual thickness of sprayed fire-resistive material is the greater of 0.375 inch (9 mm) or 75 percent of the design thickness.
 - c. No reduction in average thickness is permitted for those fire-resistance designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft. (240 kg/cu. m).
 - 3. Bond Strength: 339 PSF. (16.2 kPa) minimum per ASTM E 736 under the following conditions:
 - a. Field test sprayed fire-resistive material that is applied to flanges of wide-flange, structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.

- b. If surfaces of structural steel receiving sprayed fire-resistive material are primed or otherwise painted for coating materials, perform series of bond tests specified in UL's "Fire Resistance Directory." Provide bond strength indicated in referenced UL fire-resistance criteria, but not less than **CRITERIA ABOVE**.
 - c. Minimum thickness of sprayed fire-resistive material tested in laboratory shall be **0.75 inch (19 mm)**.
- 4. Compressive Strength: **1440 lbf/sq. in. (68.9 kPa)** as determined in the laboratory per ASTM E 761. Minimum thickness of sprayed fire-resistive material tested shall be **0.75 inch (19 mm)** and minimum dry density shall be as specified, but not less than **15 lb/cu. ft. (240 kg/cu. m)**.
- 5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
- 6. Deflection: No cracking, spalling, or delamination per ASTM E 759.
- 7. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.
- 8. Air Erosion: Maximum weight loss of **0.000 g/sq. ft. (0.0 g/sq. m)** in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of sprayed fire-resistive material is **0.75 inch (19 mm)**, maximum dry density is **15 lb/cu. ft. (240 kg/cu. m)**, test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.
- 9. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Flame-Spread Index: **0**.
 - b. Smoke-Developed Index: **0**.

2.2 AUXILIARY FIRE-RESISTIVE MATERIALS

- A. General: Provide auxiliary fire-resistive materials that are compatible with sprayed fire-resistive materials and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: For use on each substrate and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:
 - 1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory," for coating materials based on a series of bond tests per ASTM E 736.
 - 2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of sprayed fire-resistive material per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

- C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of sprayed fire-resistive material.
- D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistance designs indicated and fire-resistive material manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.
- E. Sealer for Sprayed-Fiber Fire-Resistive Material: Transparent-drying, water-dispersible protective coating recommended in writing by manufacturer of sprayed-fiber fire-resistive material.
- F. Topcoat: Type recommended in writing by manufacturer of each sprayed fire-resistive material for application over **concealed** sprayed fire-resistive materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:
 - 1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
 - 2. Substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
 - 3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.
- B. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of oil, rolling compounds, and other substances capable of interfering with bond.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application.

- B. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, loose mill scale, and incompatible primers, paints, and encapsulants.

3.3 INSTALLATION, GENERAL

- A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- B. Apply sprayed fire-resistive material that is identical to products tested as specified in Part 1 "Quality Assurance" Article and substantiated by test reports, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.
- C. Install metal lath, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer. Attach lathing accessories where indicated or required for secure attachment to substrate.
- D. Coat substrates with adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by sprayed fire-resistive material manufacturer for material and application indicated.
- E. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by sprayed fire-resistive material manufacturer, install body of fire-resistive covering in a single course.
- F. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.
- G. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply sprayed fire-resistive material that differs in color from that of encapsulant over which it is applied.
- H. Where sealers are used, apply products that are tinted to differentiate them from sprayed fire-resistive material over which they are applied.

3.4 INSTALLATION, CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

- A. Apply concealed sprayed fire-resistive material in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition,

but apply in greater thicknesses and densities if specified in Part 2 "Concealed Sprayed Fire-Resistive Materials" Article.

- B. Apply water overspray to concealed sprayed-fiber fire-resistive material as required to obtain designated fire-resistance rating.
- C. Apply sealer to concealed sprayed fire-resistive material.
- D. Apply topcoat to concealed sprayed fire-resistive material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of completed applications of sprayed fire-resistive material shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of sprayed fire-resistive material for the next area until test results for previously completed applications of sprayed fire-resistive material show compliance with requirements. Tested values must equal or exceed values indicated and required for approved fire-resistance design.
- C. Remove and replace applications of sprayed fire-resistive material where test results indicate that it does not comply with specified requirements for cohesion and adhesion, for density, or for both.
- D. Apply additional sprayed fire-resistive material per manufacturer's written instructions where test results indicate that thickness does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING, PROTECTING, AND REPAIR

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect sprayed fire-resistive material, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at time of Substantial Completion.

- C. Coordinate application of sprayed fire-resistive material with other construction to minimize need to cut or remove fire protection. As installation of other construction proceeds, inspect sprayed fire-resistive material and patch any damaged or removed areas.
- D. Repair or replace work that has not been successfully protected.

END OF SECTION 07811

SECTION 07841 - THROUGH-PENETRATION FIRESTOP SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:
 - 1. Floors.
 - 2. Roofs.
 - 3. Walls and partitions.
 - 4. Shafts.
 - 5. Smoke barriers.
- B. Related Sections include the following:
 - 1. Division 7 Section "Sprayed Fire-Resistive Materials."
 - 2. Division 15 Sections specifying duct and piping penetrations.
 - 3. Division 16 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

- A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
 - 1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
 - 2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
 - 3. Fire-resistance-rated floor assemblies.
 - 4. Fire-resistance-rated roof assemblies.
- B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

- C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
 - 1. Penetrations located outside wall cavities.
 - 2. Penetrations located outside fire-resistive shaft enclosures.
 - 3. Penetrations located in construction containing fire-protection-rated openings.
 - 4. Penetrating items larger than 4-inch- (100-mm-) diameter nominal pipe or 16 sq. in. (100 sq. cm) in overall cross-sectional area.
- D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
 - 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- E. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

1.4 SUBMITTALS

- A. Product Data: For each type of through-penetration firestop system product indicated.
- B. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.
 - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
 - 2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects

with project names and addresses, names and addresses of architects and owners, and other information specified.

- D. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.
- E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed through-penetration firestop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is **UL**, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
 - 1) UL in "Fire Resistance Directory."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's building inspector has examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. DAP Inc.
 - 2. Hilti Construction Chemicals, Inc.
 - 3. 3M Fire Protection Products.
 - 4. Tremco.
 - 5. United States Gypsum Company.

2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and

application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-/rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.

2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

- G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- H. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- I. Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.
- J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- K. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
 - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
 - 3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Inspecting: Owner will inspect through-penetration firestop systems.
- B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection.
- C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

- A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - 1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Through-penetration firestop system designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Through-penetration firestop system manufacturer's name.
 - 6. Installer's name.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION 07841

SECTION 07920 - JOINT SEALANTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

| | |
|-------------------|----------------------------|
| ASTM C 834 (1995) | Latex Sealants |
| ASTM C 920 (1998) | Elastomeric Joint Sealants |

1.2 SUBMITTALS

Product Data

Sealants

Primers

Bond breakers

Backstops

Data for the sealants shall include:

Shelf life and recommended cleaning solvents.

1.3 ENVIRONMENTAL CONDITIONS

The ambient temperature shall be within the limits of 4 and 38 degrees C 40 and 100 degrees F when sealant is applied.

1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, [color,] and material designation clearly marked thereon. Elastomeric sealant containers shall be labeled to identify type, class, grade, and use.

Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 38 degrees C 100 F degrees or less than 4 degrees C 0 degrees F.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

2.1.1 Interior Sealant

Location(s) of sealant shall include:

LOCATION

- a. Small voids between walls or partitions and adjacent casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items.
- b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.
- c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.
- d. Joints between edge members for acoustical tile and adjoining vertical surfaces.
- e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.
- f. Existing cracks in exterior wall.

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T.

2.1.3 Floor Joint Sealant

ASTM C 920, Type S or M, Grade P, Class 25, Use T.

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer for the particular application.

2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Backstop material shall be compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces shall be clean, dry to the touch, and free from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. When resealing an existing joint, remove existing calk or sealant prior to applying new sealant.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.1.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

| | JOINT WIDTH | JOINT DEPTH |
|--|--|----------------|
| Minimum Maximum | | |
| For metal, glass, or other nonporous surfaces: | | |
| 1/4 inch (minimum) | 1/4 inch | 1/4 inch |
| over 1/4 inch | 1/2 of width | Equal to width |
| For wood, concrete, masonry, stone: | | |
| 1/4 inch (minimum) | 1/4 inch | 1/4 inch |
| Over 1/4 inch to 1/2 inch | 1/4 inch | Equal to Width |
| Over 1/2 inch to 2 inches | 1/2 inch | 5/8 inch |
| Over 2 inches | As recommended by sealant manufacturer | |

- b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding shall not be required on metal surfaces.

3.3.2 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

- a. Where indicated.
- b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios."

3.3.3 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.4 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid

contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.5 Sealants

Provide a sealant compatible with the material(s) to which it is applied.

Do not use a sealant that has exceeded shelf life or has jelled and cannot be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Sealant shall be uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

- a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.
- b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

END OF SECTION

SECTION 08110 - STEEL FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fire-rated door and frame assemblies.
 - 2. Fire-rated window frames.
- B. Related Sections include the following:
 - 1. Division 8 Section "Flush Wood Doors" for wood doors installed in steel frames.
 - 2. Division 8 Section "Door Hardware (Scheduled by Naming Products)" for door hardware and weather stripping.
 - 3. Division 8 Section "Glazing" for glass in glazed openings in **frames**.
 - 4. Division 9 Section "Painting" for field painting factory-primed doors and frames.
 - 5. Division 9 Section "Gypsum Board Assemblies" for spot-grouting frames installed in steel-framed gypsum board partitions.

1.3 DEFINITIONS

- A. Steel Sheet Thicknesses: Thickness dimensions, including those referenced in ANSI A250.8, are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets.

1.4 SUBMITTALS

- A. Product Data: For each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, sound and fire-resistance ratings, and finishes.
- B. Shop Drawings: Show the following:
 - 1. Frame details for each frame type including dimensioned profiles.
 - 2. Details and locations of reinforcement and preparations for hardware.
 - 3. Details of each different wall opening condition.
 - 4. Details of anchorages, accessories, joints, and connections.
 - 5. Coordination of glazing frames and stops with glass and glazing requirements.

- C. Frame Schedule: Use same reference designations indicated on Drawings in preparing schedule for frames.
- D. Oversize Construction Certificates: For door assemblies required to be fire-protection rated and exceeding size limitations of labeled assemblies.

1.5 QUALITY ASSURANCE

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.
 - 1. Test Pressure: Test at atmospheric pressure.
 - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 3. Temperature-Rise Rating: Where indicated, provide doors that have a temperature-rise rating of **450 deg F** maximum in 30 minutes of fire exposure.
- B. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage.
- B. Inspect doors and frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.
- C. Store doors and frames at building site under cover. Place units on minimum **4-inch** high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately. Provide minimum **1/4-inch** spaces between stacked doors to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Steel Frames:

- a. Amweld Building Products, Inc.
- b. Kewanee Corporation (The).
- c. Pioneer Industries Inc.
- d. Republic Builders Products.
- e. Steelcraft; a division of Ingersoll-Rand.

2.2 MATERIALS

- A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

2.3 FRAMES

- A. General: Provide steel frames for doors, transoms, sidelights, borrowed lights, and other openings that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.
- B. Frames of 0.067-inch- (1.7-mm-) thick steel sheet for:
1. Wood doors, **unless otherwise indicated.**
- C. Door Silencers: Except on weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames.
- D. Plaster Guards: Provide 0.016-inch- (0.4-mm-) thick, steel sheet plaster guards or mortar boxes to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.
- E. Supports and Anchors: Fabricated from not less than 0.042-inch- (1.0-mm-) thick, electrolytic zinc-coated or metallic-coated steel sheet.
- F. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.

2.4 FABRICATION

- A. General: Fabricate steel frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.
- B. Clearances for Fire-Rated Doors: As required by NFPA 80.
- C. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- D. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.
- E. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- F. Sound-Rated (Acoustical) Assemblies: Where shown or scheduled, provide frame assemblies fabricated as sound-reducing type, tested according to ASTM E 1408, and classified according to ASTM E 413.
 - 1. Unless otherwise indicated, provide acoustical assemblies with STC sound ratings of **33** or better.
- G. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
- H. Frame Construction: Fabricate frames to shape shown.
 - 1. Fabricate frames with mitered or coped and continuously welded corners **and seamless face joints, unless otherwise indicated.**
 - 2. Provide welded frames with temporary spreader bars.
- I. Reinforce frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
- J. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.
- K. Glazing Stops: Manufacturer's standard, formed from **0.032-inch-** thick steel sheet.
 - 1. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
- L. Astragals: As required by NFPA 80 to provide fire ratings indicated.

2.5 FINISHES

1. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 1. Except for frames located in existing walls or partitions, place frames before construction of enclosing walls and ceilings.
 2. In metal-stud partitions, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Attach wall anchors to studs with screws.
 3. For in-place gypsum board partitions, install knock-down, drywall slip-on frames.
 4. Install fire-rated frames according to NFPA 80.
 5. For openings 90 inches (2286 mm) or more in height, install an additional anchor at hinge and strike jambs.

3.2 ADJUSTING AND CLEANING

- A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.
- B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 08110

SECTION 08211 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Solid-core doors with **wood-veneer** faces.
 - 2. **Factory finishing** flush wood doors.
- B. Related Sections include the following:
 - 1. Division 8 Section "STEEL FRAMES"
 - 2. Division 8 Section "ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS"
 - 3. Division 8 Section "DOOR HARDWARE"

1.3 SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. **Include factory-finishing specifications.**
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate doors to be factory finished and finish requirements.
 - 5. Indicate fire ratings for fire doors.
- C. Samples for Verification: Match Architect's sample.
 - 1. Factory finishes applied to actual door face materials, approximately **8 by 10 inches (200 by 250 mm)**, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
 - 2. Corner sections of doors, approximately **8 by 10 inches (200 by 250 mm)**, with door faces and edgings representing typical range of color and grain for each

species of veneer and solid lumber required. **Finish sample with same materials proposed for factory-finished doors.**

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.
- B. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
 - 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - 1. Test Pressure: **After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill.**
 - 2. Oversize, Fire-Rated Wood Doors: For door assemblies exceeding sizes of tested assemblies, provide oversize fire door label or certificate of inspection, from a testing and inspecting agency acceptable to authorities having jurisdiction, stating that doors comply with requirements of design, materials, and construction.
 - 3. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of **450 deg F (250 deg C)** maximum in 30 minutes of fire exposure.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in **plastic bags or cardboard cartons.**
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than **1/4 inch** in a **42-by-84-inch** section, or show telegraphing of core construction in face veneers exceeding **0.01 inch in a 3-inch** span.
 - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Flush Wood Doors:
 - a. Ampco Products, Inc.
 - b. Chappell Door Co.
 - c. Mohawk Flush Doors, Inc.
 - d. Vancouver Door Company, Inc.
 - e. Weyerhaeuser Company.

2.2 DOOR CONSTRUCTION, GENERAL

- A. Doors for Transparent Finish:
 - 1. Grade: **Premium, with Grade AA faces.**
 - 2. Species and Cut: **Cherry, Cut as selected from standards available.**
 - 3. Match between Veneer Leaves: **Book match.**
 - 4. Assembly of Veneer Leaves on Door Faces: **Balance match.**
 - 5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 - 6. Room Match: Match door faces within each separate room or area of building. Corridor door faces do not need to match where they are separated by **10 feet** or more.
 - 7. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
 - 8. Transom Match: **Continuous match.**

2.3 SOLID-CORE DOORS

A. Interior Veneer-Faced Doors:

1. Core: **Either glued block or structural composite lumber.**
2. Construction: Seven plies, either bonded or nonbonded construction.

B. Fire-Rated Doors:

1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated **as needed to eliminate through-bolting hardware.**
3. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile matching face veneer, and laminated backing at hinge stiles for improved screw-holding capability and split resistance.
4. Pairs: Furnish formed-steel edges and astragals **with intumescent seals** for pairs of fire-rated doors, unless otherwise indicated.
 - a. Finish steel edges and astragals to match door hardware (locksets or exit devices).
5. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. **Provide stiles with concealed intumescent seals.**

2.4 FABRICATION

- A. Fabricate doors in sizes indicated for Project-site fitting.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

2.5 FACTORY FINISHING

- A. General: Comply with **AWI's "Architectural Woodwork Quality Standards Illustrated"** for factory finishing.
- B. Finish doors at factory.

C. Transparent Finish:

1. Grade: **Premium**
2. Finish: Manufacturer's standard finish with performance comparable to **AWI System TR-6 catalyzed polyurethane**
3. Staining: **Match Architect's sample.**
4. Effect: **Semifilled** finish.
5. Sheen: **Satin.**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
 1. Clearances: Provide **1/8 inch (3.2 mm)** at heads, jambs, and between pairs of doors. Provide **1/8 inch (3.2 mm)** from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide **1/4 inch (6.4 mm)** from bottom of door to top of threshold.
 - a. Comply with NFPA 80 for fire-rated doors.
 2. Bevel non-fire-rated doors **1/8 inch in 2 inches (3-1/2 degrees)** at lock and hinge edges.
 3. Bevel fire-rated doors **1/8 inch in 2 inches (3-1/2 degrees)** at lock edge; trim stiles and rails only to extent permitted by labeling agency.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08211

SECTION 08411 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. **Interior** aluminum manual sliding doors.
 - 2. **Interior** aluminum frames.
- B. Related Sections include the following:
 - 1. Division 7 Section "Joint Sealants" for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
 - 2. Division 8 Section "Door Hardware" for hardware to the extent not specified in this Section.
 - 3. Division 8 Section "Glazing" for glazing requirements to the extent not specified in this Section.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
 - 1. Thermal movements.
 - 2. Movements of supporting including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 3. Dimensional tolerances of building frame and other adjacent construction.
 - 4. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units to function properly.

B. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to **13 feet 6 inches (4.1 m)** and to 1/240 of clear span plus **1/4 inch (6.35 mm)** for spans greater than **13 feet 6 inches (4.1 m)** or an amount that restricts edge deflection of individual glazing lites to **3/4 inch (19 mm)**, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or **1/8 inch (3.2 mm)**, whichever is smaller.

C. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at **150**percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding **0.2** percent of span.
3. Test Durations: As required by design wind velocity but not less than 10 seconds.

D. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of **0.06 cfm/sq. ft. (0.03 L/s per sq. m)** of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of **1.57 lbf/sq. ft. (75 Pa)**.

F. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than **53** when tested according to AAMA 1503.

G. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than **0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K)** when tested according to AAMA 1503.

H. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having minimum STC **32** according to ASTM E 413 and an OITC **26** according to ASTM E 1332, as determined by testing according to ASTM E 90.

1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Samples for Selection: Door Pull Options
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.
- F. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
- G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Accessible Entrances: Comply with **the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."**

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 WARRANTY

- A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals, **metal finishes**, and other materials beyond normal weathering.
 - d. Failure of operating components to function properly.
2. Warranty Period: **Five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Kawneer.
 2. United States Aluminum.
 3. Vistawall Architectural Products.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 1. Sheet and Plate: **ASTM B 209** (ASTM B 209M).
 2. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221** (ASTM B 221M).
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308/B 308M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Reinforce members as required to receive fastener threads.
 - 2. Use exposed fasteners with countersunk Phillips screw heads, **finished to match framing system.**
- D. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 8 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

2.5 DOORS

- A. Doors: Manufacturer's glazed doors, for manual sliding operation.
 - 1. Door Construction: **2-inch (50.8-mm) overall thickness, with minimum 0.188-inch- (4.8-mm-)** thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: **Narrow stile; 2-1/8-inch (54-mm) nominal width.**
 - a. Accessible Doors: Smooth surfaced for width of door in area within **10 inches (255 mm)** above floor or ground plane.
 - 3. Glazing Stops and Gaskets: **Square** snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.6 DOOR HARDWARE

- A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.

1. Opening-Force Requirements:

- a. Egress Doors: Not more than 30 lbf (133 N) required to set door in motion and not more than 15 lbf (67 N) required to open door to minimum required width.
- b. Accessible Interior Doors: Not more than 5 lbf (22.2 N).

2.7 SLIDING DOOR HARDWARE

- A. Standard: Comply with BHMA A156.14.
- B. Sliding Door Hardware: Provide complete sets consisting of rails, hangers, supports, bumpers, floor guides, and accessories indicated.
 - 1. Provide anodized-aluminum door hardware.
- C. Horizontal Sliding Door Hardware: BHMA Grade 1; appropriate for door weight.
 - 1. References to BHMA Standards: Provide products complying with standards referenced in this Article and with requirements for description, quality, type, and function listed..
- D. Locking Devices, General: Do not require use of key, tool, or special knowledge for operation. Hardware and locking devices shall be compatible with University of Utah cylinder and keying systems.
 - 1. Opening-Force Requirements:
 - a. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.
- E. Operating Trim: BHMA A156.6.
- F. Thresholds: Raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (13 mm).
 - 1. Standard: BHMA A156.21.

2.8 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."
- B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.9 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from **interior**.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).
- D. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
 - 1. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- E. Doors: Reinforce doors as required for installing hardware.
- F. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.
 - 1. Color: **Dark bronze**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 6. Seal joints watertight, unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Install components plumb and true in alignment with established lines and grades, without warp or rack.
- E. Install glazing as specified in Division 8 Section "Glazing."
- F. Entrances: Install to produce smooth operation and tight fit at contact points.
 - 1. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- G. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

- H. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:
1. Location and Plane: Limit variation from true location and plane to **1/8 inch in 12 feet; 1/4 inch** over total length.
 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to **1/16 inch**.
 - b. Where surfaces meet at corners, limit offset from true alignment to **1/32 inch**.
 3. Diagonal Measurements: Limit difference between diagonal measurement to **1/8 inch**.

3.3 ADJUSTING

- A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.
1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to **3 inches (75 mm)** from the latch measured to the leading door edge.

END OF SECTION 08411

SECTION 08711 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Commercial door hardware for the following:
 - a. Swinging doors.
 - b. Other doors to the extent indicated.
- B. Related Sections include the following:
 - 1. Division 8 Section "Steel Frames".
 - 2. Division 8 Section "Flush Wood Doors" for astragals provided as part of a fire-rated labeled assembly.
 - 3. Division 8 Section "Aluminum Entrances and Storefronts" for entrance door hardware, except cylinders.

1.3 SUBMITTALS

- A. Product Data: Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.
 - a. Organize door hardware sets in same order as in the Door Hardware Schedule in the Drawings.
 - 2. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.

- e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
- 1) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.
- 3. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Product Certificates: Signed by manufacturers of electrified door hardware certifying that products furnished comply with requirements.
 - 1. Certify that door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies.
 - D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
 - 1. Include lists of completed projects with project names and addresses of architects and owners, and other information specified.
 - E. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, indicating current products comply with requirements.
 - F. Maintenance Data: For each type of door hardware to include in maintenance manuals specified in Division 1.
 - G. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 - 1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- C. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute as an Architectural Hardware Consultant and who is experienced

in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

- D. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
- E. Regulatory Requirements: Comply with provisions of the following:
 - 1. Where indicated to comply with accessibility requirements, comply with **Americans with Disabilities Act (ADA)**, "**Accessibility Guidelines for Buildings and Facilities (ADAAG)**," and **ANSI A117.1**, as follows:
 - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
 - 1) Interior Hinged Doors: **5 lbf (22.2 N)** applied perpendicular to door.
 - 2) Sliding Doors: **5 lbf (22.2 N)** applied parallel to door at latch.
 - 3) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - c. Thresholds: **Not more than 1/2 inch (13 mm) high**. Bevel raised thresholds with a slope of not more than 1:2.
 - 2. NFPA 101: Comply with the following for means of egress doors:
 - a. Latches, Locks, and Exit Devices: Not more than **15 lbf (67 N)** to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force not more than **15 lbf (67 N)** for not more than 3 seconds.
 - c. Door Closers: Not more than **30 lbf (133 N)** to set door in motion and not more than **15 lbf (67 N)** to open door to minimum required width.
 - d. Thresholds: Not more than **1/2 inch (13 mm)** high.
- F. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - 1. Test Pressure: Test at atmospheric pressure.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.7 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of operators and door hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- C. Warranty Period: **Three** years from date of Substantial Completion, unless otherwise indicated.
- D. Warranty Period for Manual Closers: **10** years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section, **door hardware sets indicated in door and frame schedule, and the Door Hardware Schedule on the drawings.**
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and **named manufacturer's products or products equivalent in function and comparable in quality to named products and products complying with BHMA standard referenced.**

- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Schedule in the Drawings. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed in the door hardware schedule for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

2.2 CYLINDERS AND KEYING

- A. Cylinders and Keying: Coordinate with University System.

2.3 THRESHOLDS

- A. Standard: Comply with BHMA A156.21.

2.4 MISCELLANEOUS DOOR HARDWARE

- A. Standard: Comply with the following:
 - 1. Auxiliary Hardware: BHMA A156.16.
 - 2. Exit Alarms: BHMA A156.5.
- B. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; and listed and labeled for use with fire alarm systems.

2.5 FABRICATION

- A. Manufacturer's Nameplate: Do not provide manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification will be permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Steel Machine or Wood Screws: For the following fire-rated applications:
 - a. Mortise hinges to doors.
 - b. Strike plates to frames.
 - c. Closers to doors and frames.
3. Steel Through Bolts: For the following fire-rated applications, unless door blocking is provided:
 - a. Surface hinges to doors.
 - b. Closers to doors and frames.
 - c. Surface-mounted exit devices.
4. Spacers or Sex Bolts: For through bolting of hollow metal doors.
5. Fasteners for Wood Doors: Comply with requirements of DHI WDHS.2, "Recommended Fasteners for Wood Doors."

2.6 FINISHES

- A. Standard: Comply with BHMA A156.18.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. BHMA Designations: Comply with base material and finish requirements indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Frames: Comply with DHI A115 series.
 - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to SDI 107.
- B. Wood Doors: Comply with DHI A115-W series.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point **3 inches (75 mm)** from the latch, measured to the leading edge of the door.

3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.

- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

END OF SECTION 08711

SECTION 08800 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Doors.
 - 2. Interior windows.

1.3 DEFINITIONS

- A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.
- B. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- C. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- D. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for

various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required.

- a. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.

1.5 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: For the following products, in the form of 12-inch- (300-mm-) square Samples for glass.
 1. Each type of glass.
 2. Fire-resistive glazing products.
- C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations for Clear Glass: Obtain clear float glass from one primary-glass manufacturer.
- C. Source Limitations for Frosted Glass: Obtain frosted float glass from one primary-glass manufacturer for each tint color indicated.

- D. Source Limitations for Fire Rated Glass: Obtain fire rated from one manufacturer using the same type of glass lites and interlayers for each type of unit indicated.
- E. Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.
- F. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
- G. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.
- H. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
 - 1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
- I. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA'S "Glazing Manual."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.9 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PRIMARY FLOAT GLASS

- A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); class as indicated in schedules at the end of Part 3.

2.2 HEAT-TREATED FLOAT GLASS

- A. Fabrication Process: By vertical (tong-held) or horizontal (roller-hearth) process, at manufacturer's option, except provide horizontal process where indicated as tongless or free of tong marks.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind, and condition as indicated in schedules at the end of Part 3.

2.3 FROSTED GLASS

- A. Frosted Glass: Glass as specified and treated to obtain finish to match Architect's sample.
 - 1. Seal frosted side of glazing as required to prevent fingerprinting.

2.4 WIRED GLASS

- A. Wired Glass: ASTM C 1036, Type II (patterned and wired glass, flat), Class 1 (clear), Quality q8 (glazing); 6.4 mm thick; of form and mesh pattern indicated below:
 - 1. Polished Wired Glass: Form 1 (wired, polished both sides), and as follows:
 - a. Mesh m2 (square).
 - 2. Frosted Wired Glass: Form 2 (patterned and wired).
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Polished Wired Glass:
 - a. Ashai Glass Co./Ama Glass Corp.
 - b. Central Glass Co., Ltd.
 - c. Nippon Sheet Glass Co., Ltd.
 - 2. Frosted Wired Glass:
 - a. Ashai Glass Co./Ama Glass Corp.
 - b. Central Glass Co., Ltd.
 - c. Nippon Sheet Glass Co., Ltd.

2.5 ELASTOMERIC GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- B. Elastomeric Glazing Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied, chemically curing sealant in the Glazing Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.
- C. Glazing Sealant for Fire-Resistive Glazing Products: Identical to product used in test assembly to obtain fire-protection rating.

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tape: Closed-cell, PVC foam tape; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
1. Type 1, for glazing applications in which tape acts as the primary sealant.
 2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 GLAZING GASKETS

- A. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542, black.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
1. EPDM.
 2. Silicone.
 3. Thermoplastic polyolefin rubber.
 4. Any material indicated above.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.9 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.
- B. Grind smooth and polish exposed glass edges.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep system.
 - 3. Minimum required face or edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where the length plus width is larger than **50 inches (1270 mm)** as follows:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide **1/8-inch (3-mm)** minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.

- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

3.6 PROTECTION AND CLEANING

- A. Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.
- D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION 08800

SECTION 09260 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum wallboard.
 - 2. Non-load-bearing steel framing.
 - 3. Tile backing panels.

1.3 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from **UL's "Fire Resistance Directory."**
- B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Steel Framing and Furring:
 - a. Consolidated Systems, Inc.
 - b. National Gypsum Company.
 - c. Scafco Corporation.
 - d. Unimast, Inc.
 - e. Western Metal Lath & Steel Framing Systems.
 - 2. Gypsum Board and Related Products:
 - a. American Gypsum Co.
 - b. G-P Gypsum Corp.
 - c. National Gypsum Company.
 - d. United States Gypsum Co.

2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Components, General: Comply with ASTM C 754 for conditions indicated.
- B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.
- C. Hanger Attachments to Concrete: As follows:
 - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal

to **5** times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.

a. Type: **Postinstalled, chemical anchor**

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to **10** times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.

D. Hangers: As follows:

1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.162-inch (4.12-mm)** diameter.
2. Rod Hangers: **ASTM A 510 (ASTM A 510M)**, mild carbon steel.
 - a. Diameter: **1/4-inch (6.34-mm)**
 - b. Protective Coating: **ASTM A 153/A 153M, hot-dip galvanized or Corrosion-resistant paint.**

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of **0.0538 inch (1.37 mm)**, a minimum **1/2-inch- (12.7-mm-)** wide flange, with **manufacturer's standard corrosion-resistant** zinc coating.

F. Furring Channels (Furring Members): Commercial-steel sheet with **manufacturer's standard corrosion-resistant** zinc coating.

1. Cold Rolled Channels: **0.0538-inch (1.37-mm)** bare steel thickness, with minimum **1/2-inch- (12.7-mm-)** wide flange, **3/4 inch (19.1 mm)** deep.

2.3 STEEL PARTITION AND SOFFIT FRAMING

A. Components, General: As follows:

1. Comply with ASTM C 754 for conditions indicated.
2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with **manufacturer's standard corrosion-resistant** zinc coating.

B. Steel Studs and Runners: ASTM C 645.

1. Minimum Base Metal Thickness: **0.0312 Inch (0.79 mm).**
2. Depth: **As indicated**

C. Deep-Leg Deflection Track: ASTM C 645 top runner with **2-inch- (50.8-mm-)** deep flanges.

- D. Proprietary Firestop Track: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Available Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Trak Corp.; Fire Trak **attached to studs with Fire Trak Slip Clip.**
 - b. Metal-Lite, Inc.; The System.
- E. Cold-Rolled Furring Channels: **0.0538-inch (1.37-mm)** bare steel thickness, with minimum **1/2-inch- (12.7-mm-)** wide flange.
 - 1. Depth: **As indicated.**
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of **0.0312 inch (0.79 mm).**
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.0625-inch- (1.59-mm-)** diameter wire, or double strand of **0.0475-inch- (1.21-mm-)** diameter wire.
- F. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.4 INTERIOR GYPSUM WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: ASTM C 36.
 - 1. Type X:
 - a. Thickness: **5/8 inch (15.9 mm).**
 - b. Long Edges: **Tapered**
 - c. Location: **Vertical surfaces, unless otherwise indicated.**
- C. Sag-Resistant Gypsum Wallboard: ASTM C 36, manufactured to have more sag resistance than regular-type gypsum board.
 - 1. Thickness: **1/2 inch (12.7 mm).**
 - 2. Long Edges: **Tapered.**
 - 3. Location: **Ceiling surfaces.**

2.5 TILE BACKING PANELS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

- B. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M.

1. Core: **5/8 inch (15.9 mm), Type X.**

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.

1. Material: **Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.**
2. Shapes:
 - a. Cornerbead: Use at outside corners, **unless otherwise indicated.**
 - b. U-Bead: J-shaped; exposed short flange does not receive joint compound; use **at exposed panel edges.**
 - c. Expansion (Control) Joint: Use **where indicated.**

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.

- B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.8 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

2.9 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
- D. Isolation Strip at Exterior Walls:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.
- E. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fire-resistive

materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (600 mm) o.c.

2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
 2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.

3.4 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Suspend ceiling hangers from building structure as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.

4. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 6. Do not attach hangers to steel deck tabs.
 7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within **1/8 inch in 12 feet (3 mm in 3.6 m)** measured lengthwise on each member and transversely between parallel members.
- C. Sway-brace suspended steel framing **with hangers used for support**.
- D. Wire-tie **or clip** furring channels to supports, **as required to comply with requirements for assemblies indicated**.
- E. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
1. Hangers: **48 inches (1219 mm)** o.c.
 2. Carrying Channels (Main Runners): **48 inches (1219 mm)** o.c.
 3. Furring Channels (Furring Members): **16 inches (406 mm)** o.c.

3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
1. Where studs are installed directly against exterior walls, install **asphalt-felt or foam-gasket** isolation strip between studs and wall.
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than **1/8 inch (3 mm)** from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate 6" above suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
1. Cut studs **1/2 inch (13 mm)** short of full height to provide perimeter relief. Do not fasten studs to top track to allow independent movement of studs and track.

2. For **fire-resistance-rated and STC-rated** partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
- D. Install steel studs and furring at the following spacings:
1. **16 inches (406 mm)** o.c., unless otherwise indicated.
- E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
1. Install two studs at each jamb, unless otherwise indicated.
 2. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- G. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

3.6 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch (1.5 mm)** of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Form control and expansion joints with space between edges of adjoining gypsum panels.
- I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect open concrete coffer, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffer, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- K. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
 - 1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.
- M. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.
- N. Tile Backing Panels:
 - 1. Water-Resistant Gypsum Backing Board: Install at showers, tubs, and where indicated. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
 - 2. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.7 PANEL APPLICATION METHODS

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels **vertically (parallel to framing)** unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.

B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Curved Partitions:

1. Install panels horizontally and unbroken, to the extent possible, across curved surface plus **12-inch- (300-mm-)** long straight sections at ends of curves and tangent to them.
2. Wet gypsum panels on surfaces that will become compressed where curve radius prevents using dry panels. Comply with gypsum board manufacturer's written recommendations for curve radii, wetting methods, stacking panels after wetting, and other preparations that precede installing wetted gypsum panels.
3. On convex sides of partitions, begin installation at one end of curved surface and fasten gypsum panels to studs as they are wrapped around curve. On concave side, start fastening panels to stud at center of curve and work outward to panel ends. Fasten panels to framing with screws spaced **12 inches (300 mm)** o.c.
4. For double-layer construction, fasten base layer to studs with screws **16 inches (400 mm)** o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced **12 inches (300 mm)** o.c.
5. Allow wetted gypsum panels to dry before applying joint treatment.

3.8 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: **Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.**

3.9 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 - 1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, **unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.**
 - 2. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface.

END OF SECTION 09260

SECTION 09310 - CERAMIC TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Ceramic mosaic tile.
 - 2. Glazed wall tile.
 - 3. Thresholds installed as part of tile installations.
 - 4. Crack-suppression membrane for thin-set tile installations.
 - 5. Metal edge strips installed as part of tile installations.
- B. Related Sections include the following:
 - 1. Division 1 Section "Selective Demolition" for removing existing finishes.
 - 2. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 3. Division 9 Section "**Ceramic Tile**" for tile installations.

1.3 DEFINITIONS

- A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.
- B. Facial Dimension: Actual tile size (minor facial dimension as measured per ASTM C 499).
- C. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
 - 1. Level Surfaces: Minimum 0.6.
 - 2. Step Treads: Minimum 0.6.
 - 3. Ramp Surfaces: Minimum 0.8.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.
- C. Product Certificates: For each type of product, signed by product manufacturer.
- D. Qualification Data: For Installer.
- E. Material Test Reports: For each tile-setting and -grouting product.

1.6 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain all **tile** from one source or producer.
 - 1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
 - 1. Stone thresholds.
 - 2. Joint sealants.
 - 3. Metal edge strips.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store **liquid latexes and emulsion adhesives** in unopened containers and protected from freezing.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: **Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.**

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
 - 2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 - 1. **As selected by Architect from manufacturer's full range.**
- D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
 - 1. Where tile is indicated for installation **in wet areas**, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.2 TILE PRODUCTS

- A. Manufacturers:
 - 1. American Olean; Div. of Dal-Tile International Corp.
 - 2. Crossville Ceramics Company, L.P.
 - 3. Daltile; Div. of Dal-Tile International Inc.
- B. Unglazed Ceramic Mosaic Tile: Factory-mounted flat tile as follows:
 - 1. Composition: **Vitreous or impervious natural clay or porcelain.**

2. Surface: **Smooth, without** abrasive admixture.
3. Module Size: **2 by 2 inches (50.8 by 50.8 mm)**
4. Nominal Thickness: **1/4 inch (6.35 mm)**.
5. Face: **Plain** with cushion edges.

C. Glazed Wall Tile: Flat tile as follows:

1. Module Size: **4-1/4 by 4-1/4 inches (108 by 108 mm)**.
2. Thickness: **5/16 inch (8 mm)**.
3. Face: **Plain with modified square edges or cushion edges**.
4. Finish: **Semimat, opaque** glaze.
5. Mounting: Factory back-mounted.

D. Glazed Wall Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes, selected from manufacturer's standard shapes:

1. Base for Thin-Set Mortar Installations: Straight, module size **4-1/4 by 4-1/4 inches (108 by 108 mm)**.
2. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size **4-1/4 by 4-1/4 inches (108 by 108 mm)**.
3. External Corners for Thin-Set Mortar Installations: Surface bullnose.
4. Internal Corners: Field-buttet square corners except with coved base and cap angle pieces designed to fit with stretcher shapes.

E. Ceramic Mosaic Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes, selected from manufacturer's standard shapes:

1. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from **1/2 to 1/4 inch (12.7 to 6.35 mm)** across nominal **4-inch (100-mm)** dimension.

F. Accessories for Glazed Wall Tile: Provide vitreous china accessories of type and size indicated, in color and finish to match adjoining wall tile, and intended for installing by same method as adjoining wall tile.

2.3 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to **1/2 inch (12.7 mm)** or less, and finish bevel to match face of threshold.

B. Solid Polymer Thresholds: Made from homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without precoated finish. Match countertops.

1. Manufacturers:
 - a. Dupont Corian, or approved equal.

2.4 CRACK-SUPPRESSION MEMBRANES FOR THIN-SET TILE INSTALLATIONS

- A. General: Manufacturer's standard product that complies with ANSI A118.10.

2.5 SETTING AND GROUTING MATERIALS

- A. **Available** Manufacturers:
 - 1. LATICRETE International Inc.
 - 2. MAPEI Corporation.
- B. Dry-Set Portland Cement Mortar (Thin Set): ANSI A118.1.
 - 1. For wall applications, provide nonsagging mortar that complies with Paragraph C-4.6.1 in addition to the other requirements in ANSI A118.1.
- C. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:
 - 1. Prepackaged dry-mortar mix containing dry, redispersible, ethylene vinyl acetate additive to which only water must be added at Project site.
 - 2. Prepackaged dry-mortar mix combined with **acrylic resin or styrene-butadiene-rubber** liquid-latex additive.
 - a. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.
- D. Chemical-Resistant, Water-Cleanable, Tile-Setting and -Grouting Epoxy: ANSI A118.3.
 - 1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to **140 deg F (60 deg C)** and **212 deg F (100 deg C)**, respectively, and certified by manufacturer for intended use.
- E. Water-Cleanable, Tile-Setting Epoxy Adhesive: ANSI A118.3.
- F. Organic Adhesive: ANSI A136.1, Type I.
- G. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
- H. Chemical-Resistant, Water-Cleanable, Tile-Setting and -Grouting Epoxy: ANSI A118.3.

2.6 ELASTOMERIC SEALANTS

- A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants."
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

- C. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.

1. **Available** Products:

- a. Bostik; Chem-Calk 550.
- b. Mameco International, Inc.; Vulkem 245.
- c. Pecora Corporation; NR-200 Urexpan.
- d. Tremco, Inc.; THC-900.

- D. Chemical-Resistant Sealants: For chemical-resistant floors, provide chemical-resistant elastomeric sealant of type recommended and produced by chemical-resistant mortar and grout manufacturer for type of application indicated, with proven service record and compatibility with tile and other setting materials, and with chemical resistance equivalent to mortar/grout. Include primer and backer rod recommended by manufacturer.

2.7 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- C. Grout Sealer: Manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

1. **Available** Products:

- a. Bonsal, W. R., Company; Grout Sealer.
- b. Bostik; CeramaSeal Grout Sealer.
- c. MAPEI Corporation; KER 003, **Silicone Spray Sealer for Cementitious Tile Grout & 004, Keraseal Penetrating Sealer for Unglazed Grout and Tile.**
- d. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.

2.8 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
- B. Provide concrete substrates for tile floors installed with **thin-set mortar** that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
 - 1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
 - 2. Remove protrusions, bumps, and ridges by sanding or grinding.
- C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight

aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

- E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
- F. Lay out tile wainscots to next full tile beyond dimensions indicated.
- G. Grout tile to comply with requirements of the following tile installation standards:
 - 1. For ceramic tile grouts (sand-portland cement; dry-set, commercial portland cement; and latex-portland cement grouts), comply with ANSI A108.10.
 - 2. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

3.4 CRACK-SUPPRESSION MEMBRANE INSTALLATION

- A. Install crack-suppression membrane to comply with manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.

3.5 FLOOR TILE INSTALLATION

- A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.
- B. Joint Widths: Install tile on floors with the following joint widths:
 - 1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).
- C. Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise recommended by threshold manufacturer.
 - 1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.
- D. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- E. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

3.6 WALL TILE INSTALLATION

- A. Install types of tile designated for wall installations to comply with requirements, and TCA installation methods and ANSI setting-bed standards.
- B. Joint Widths: Install tile on walls with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).
2. Glazed Wall Tile: 1/16 inch (1.6 mm).

3.7 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Remove grout residue from tile as soon as possible.
 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
- B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09310

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS

- A. CAC: Ceiling Attenuation Class.
- B. LR: Light Reflectance coefficient.
- C. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of **6-inch- (150-mm-)** square min. Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of **12-inch- (300-mm-)** long Samples of each type, finish, and color.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
- D. Research/Evaluation Reports: For each acoustical panel ceiling and components.
- E. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
 - a. Smoke-Developed Index: 450 or less.
- C. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - 1. Cisca's Guidelines for Systems Requiring Seismic Restraint: Comply with Cisca's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies-- Seismic Zones 3 & 4."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.

2.2 MINERAL-BASE ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

- A. Products: See Drawings.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern.
- C. Color: **As selected from manufacturer's full range.**
- D. LR: Not less than 0.80.
- E. NRC: Not less than 0.65.
- F. CAC: Not less than 40.
- G. Edge Detail: **Reveal sized to fit flange of exposed suspension system members.**
- H. Thickness: 3/4 inch (19 mm) minimum.
- I. Size: **24 by 24 inches (610 by 610 mm)** and **24 by 48 inches (610 by 1220 mm)**. See reflected ceiling plans in drawings for locations of each size.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
 - 1. Anchors in Concrete: Anchors of type and material appropriate for existing conditions, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Postinstalled adhesive anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than **0.135-inch- (3.5-mm-)** diameter wire.
- E. **Hanger Rods** and/or **Flat Hangers**: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than **7/8 inch (22 mm)** wide; formed with **0.04-inch- (1-mm-)** thick, galvanized steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation; with bolted connections and **5/16-inch- (8-mm-)** diameter bolts.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Product: See Drawings.

- B. Narrow-Face, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/653M, not less than **G30 (Z90)** coating designation, with prefinished **9/16-inch- (15-mm-)** wide metal caps on flanges.
 - 1. Structural Classification: **Heavy-duty** system.
 - 2. Face Design: **Flanges formed with an integral center reveal.**
 - 3. Cap Material: **Steel or aluminum** cold-rolled sheet.
 - 4. Finish: **Painted white.**
- C. Manufacturers:
 - 1. **USG Interiors, Inc, or approved equal.**
- D. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
 - 1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 - 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
 - 3. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.

2.5 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION, GENERAL

- A. General: Install acoustical panel ceilings to comply with **ASTM C 636** and seismic requirements indicated, per manufacturer's written instructions and Cisca's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to any existing cast-in-place hanger inserts, postinstalled adhesive anchors.
 - 7. Do not attach hangers to steel deck tabs.
 - 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.

9. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs.
- D. Install edge moldings and trim at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.66 m). Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 1. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 2. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09511

SECTION 09651 - RESILIENT FLOOR TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Solid vinyl floor tile.
 - 2. Rubber floor tile.
 - 3. Vinyl composition tile (VCT).
 - 4. Resilient **[wall base]** **[and]** **[accessories]**.
- B. Related Sections include the following:
 - 1. Division 9 Section "Resilient Athletic Flooring" for resilient floor tile for use in athletic-activity or support areas.
 - 2. Division 9 Section "Resilient Wall Base and Accessories" for resilient wall base, reducer strips, and other accessories installed with resilient floor tile.
 - 3. Division 9 Section "Linoleum Floor Coverings" for linoleum floor tile.
 - 4. Division 9 Section "Static-Control Resilient Floor Coverings" for resilient floor tile designed to control electrostatic discharge (ESD).

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required.
 - 1. Resilient **[Wall Base]** **[and]** **[Accessories]**: Manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long, of each resilient product color and pattern required.
- D. Maintenance Data: For resilient products to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store tiles on flat surfaces.

1.6 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than [70 deg F (21 deg C)] <Insert temperature> or more than [95 deg F (35 deg C)] <Insert temperature>, in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than [55 deg F (13 deg C)] <Insert temperature> or more than [95 deg F (35 deg C)] <Insert temperature>.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish 1 box for every [50] <Insert number> boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
 - 2. Resilient [Wall Base] [and] [Accessories]: Furnish not less than [10 linear feet (3 linear m)] <Insert length> for every [500 linear feet (150 linear m)] <Insert length> or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products listed in other Part 2 articles.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 COLORS AND PATTERNS

- A. Colors and Patterns: [As selected by Architect from manufacturer's full range] [As indicated by manufacturer's designations].

2.3 SOLID VINYL FLOOR TILE <Insert drawing designation, e.g., SVT-1.>

- A. Solid Vinyl Floor Tile: ASTM F 1700.
 - 1. Amtico International Inc.; <Insert product>.
 - 2. Armstrong World Industries, Inc.; <Insert product>.
 - 3. Azrock Commercial Flooring, DOMCO; <Insert product>.
 - 4. Estrie, American Biltrite (Canada) Ltd.; <Insert product>.
 - 5. GEMTEC, Inc.; <Insert product>.
 - 6. Marley Flexco (USA), Inc.; <Insert product>.
 - 7. Roppe Corporation; <Insert product>.
 - 8. TOLI International; <Insert product>.
 - 9. VPI, LLC, Floor Products Division; <Insert product>.
 - 10. <Insert manufacturer's name; product.>
- B. Class: [As indicated by product designations] [I, Monolithic Vinyl Tile] [II, Surface-Decorated Vinyl Tile] [III, Printed Film Vinyl Tile].
- C. Type: [A, Smooth Surface] [B, Embossed Surface].
- D. Thickness: [0.080 inch (2.0 mm)] [0.100 inch (2.5 mm)] [0.120 inch (3.0 mm)] [0.125 inch (3.2 mm)].
- E. Size: [12 by 12 inches (305 by 305 mm)] [18 by 18 inches (457 by 457 mm)] [24 by 24 inches (610 by 610 mm)] [36 by 36 inches (914 by 914 mm)] [3 by 36 inches (76 by 914 mm)] <Insert size>.
- F. Fire-Test-Response Characteristics:

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

2.4 RUBBER FLOOR TILE <Insert drawing designation, e.g., RT-1.>

A. Rubber Floor Tile: ASTM F 1344.

1. AFCO-USA, American Floor Products Company, Inc.; <Insert product>.
2. Burke Mercer Flooring Products; <Insert product>.
3. Dodge-Regupol Inc., distributed by Gerbert Limited; <Insert product>.
4. Endura; <Insert product>.
5. Estrie, American Biltrite (Canada) Ltd.; <Insert product>.
6. Johnsonite; <Insert product>.
7. Marley Flexco (USA), Inc.; <Insert product>.
8. Mondo Rubber International, Inc.; <Insert product>.
9. Musson, R. C. Rubber Co.; <Insert product>.
10. Nora Rubber Flooring, Freudenberg Building Systems, Inc.; <Insert product>.
11. Pirelli Rubber Flooring; <Insert product>.
12. R.C.A. Rubber Company (The); <Insert product>.
13. Roppe Corporation; <Insert product>.
14. <Insert manufacturer's name; product.>

B. Class: [I-A (homogeneous rubber tile, solid color)] [I-B (homogeneous rubber tile, through mottled)].

C. Hardness: [Not less than required by ASTM F 1344] [Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D 2240].

D. Wearing Surface: [Smooth] [Textured] [Molded pattern].

1. Molded-Pattern Figure: [Raised discs] [Raised squares] <Insert pattern>.

E. Thickness: [0.125 inch (3.2 mm)] <Insert thickness>.

F. Size: [12 by 12 inches (305 by 305 mm)] [24 by 24 inches (610 by 610 mm)] <Insert size>.

G. Fire-Test-Response Characteristics:

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

2.5 VINYL COMPOSITION TILE <Insert drawing designation, e.g., VCT-1.>

A. Vinyl Composition Tile (VCT): ASTM F 1066.

1. AB ColorPlus, American Biltrite (Canada) Ltd.; <Insert product>.

2. Armstrong World Industries, Inc.; <Insert product>.
3. Azrock Commercial Flooring, DOMCO; <Insert product>.
4. Congoleum Corporation; <Insert product>.
5. Mannington Mills, Inc.; <Insert product>.
6. Tarkett Inc.; <Insert product>.
7. <Insert manufacturer's name; product.>

B. Class: [1 (solid-color tile)] [2 (through-pattern tile)] [3 (surface-pattern tile)].

C. Wearing Surface: [Smooth] [Embossed].

D. Thickness: [0.125 inch (3.2 mm)] <Insert thickness>.

E. Size: 12 by 12 inches (305 by 305 mm).

F. Fire-Test-Response Characteristics:

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

2.6 RESILIENT WALL BASE <Insert drawing designation, e.g., WB-1.>

A. Wall Base: ASTM F 1861.

1. AFCO-USA, American Floor Products Company, Inc.; <Insert product>.
2. Armstrong World Industries, Inc.; <Insert product>.
3. Azrock Commercial Flooring, DOMCO; <Insert product>.
4. Burke Mercer Flooring Products; <Insert product>.
5. Endura; <Insert product>.
6. Estrie, American Biltrite (Canada) Ltd.; <Insert product>.
7. Johnsonite; <Insert product>.
8. Marley Flexco (USA), Inc.; <Insert product>.
9. Mondo Rubber International, Inc.; <Insert product>.
10. Musson, R. C. Rubber Co.; <Insert product>.
11. Nora Rubber Flooring, Freudenberg Building Systems, Inc.; <Insert product>.
12. Pirelli Rubber Flooring; <Insert product>.
13. Roppe Corporation; <Insert product>.
14. Stoler Industries; <Insert product>.
15. VPI, LLC, Floor Products Division; <Insert product>.
16. <Insert manufacturer's name; product.>

B. Type (Material Requirement): [TV (vinyl)] [TS (rubber, vulcanized thermoset)] [TP (rubber, thermoplastic)] [TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic)].

C. Group (Manufacturing Method): [I (solid, homogeneous) or II (layered)] [I (solid)] [II (layered)].

- D. Style: [Cove (with top-set toe)] [Straight (toeless)] [Butt-to (cove with extended square-edge toe that fits flush to floor covering)] <Insert special style>.
- E. Minimum Thickness: [0.125 inch (3.2 mm)] [0.080 inch (2.0 mm)] <Insert thickness>.
- F. Height: [2-1/2 inches (64 mm)] [4 inches (102 mm)] [6 inches (152 mm)].
- G. Lengths: [Cut lengths, 48 inches (1219 mm) long] [Coils in manufacturer's standard length] [Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length].
- H. Outside Corners: [Job formed] [Premolded] [Job formed or premolded].
- I. Inside Corners: [Job formed] [Premolded] [Job formed or premolded].
- J. Surface: Smooth.

2.7 RESILIENT STAIR ACCESSORIES <Insert drawing designation, e.g., RS-1.>

- A. Treads: FS RR-T-650.
 - 1. AFCCO-USA, American Floor Products Company, Inc.; <Insert product>.
 - 2. Burke Mercer Flooring Products; <Insert product>.
 - 3. Endura; <Insert product>.
 - 4. Estrie, American Biltrite (Canada) Ltd.; <Insert product>.
 - 5. Johnsonite; <Insert product>.
 - 6. Marley Flexco (USA), Inc.; <Insert product>.
 - 7. Mondo Rubber International, Inc.; <Insert product>.
 - 8. Musson, R. C. Rubber Co.; <Insert product>.
 - 9. Nora Rubber Flooring, Freudenberg Building Systems, Inc.; <Insert product>.
 - 10. Pirelli Rubber Flooring; <Insert product>.
 - 11. R.C.A. Rubber Company (The); <Insert product>.
 - 12. Roppe Corporation; <Insert product>.
 - 13. Stoler Industries; <Insert product>.
 - 14. <Insert manufacturer's name; product.>
- B. Material: [Rubber, Composition A] [Vinyl, Composition B].
- C. Surface Design: Type [1 design (smooth)] [2 design (designed)].
 - 1. Type 2 Design: [Raised-disc pattern] [Raised-square pattern] [Raised-chevron pattern] [Raised-diamond pattern] [Raised-rib pattern] [Raised-rib pattern with abrasive strips] <Insert pattern>.
 - 2. Abrasive Strips: <Insert abrasive strip requirements.>
- D. Nosing Style: [Square, adjustable to cover angles between 60 and 90 degrees] [Square] [Round].

- E. Nosing Height: [1-1/2 inches (38 mm)] [2 inches (51 mm)] [2-3/16 inches (56 mm)] <Insert dimension>.
- F. Thickness: <Insert thickness.>
- G. Size: Lengths and depths to fit each stair tread [in one piece] [in one piece or, for treads exceeding maximum lengths manufactured, in equal-length units].
- H. Risers: Smooth, flat, [coved-toe, 7 inches (178 mm) high by length matching treads] [toeless, height and length to cover risers]; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
 - 1. Thickness: [0.125 inch (3.2 mm)] [0.080 inch (2.0 mm)].
- I. Stringers: Of same thickness as risers, height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
- J. Fire-Test-Response Characteristics:
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

2.8 RESILIENT MOLDING ACCESSORY <Insert drawing designation, e.g., RM-1.>

- A. Description: [Cap for cove carpet] [Cap for cove resilient sheet floor covering] [Carpet bar for tackless installations] [Carpet edge for glue-down applications] [Nosing for carpet] [Nosing for resilient floor covering] [Reducer strip for resilient floor covering] [Joiner for tile and carpet] <Insert description>.
 - 1. Burke Mercer Flooring Products; <Insert product>.
 - 2. Johnsonite; <Insert product>.
 - 3. Marley Flexco (USA), Inc.; <Insert product>.
 - 4. Roppe Corporation; <Insert product>.
 - 5. Stoler Industries; <Insert product>.
 - 6. <Insert manufacturer's name; product.>
- B. Material: [Vinyl] [Rubber].
- C. Profile and Dimensions: [As indicated] <Insert profile and dimensions>.

2.9 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.

- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
- C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - 3. Moisture Testing:
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] <Insert emission> in 24 hours.
 - b. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- E. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- F. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are same temperature as space where they are to be installed.
- G. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles **[square with room axis] [at a 45-degree angle with room axis] [in pattern indicated] <Insert requirements>**.
- B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles **[with grain running in one direction] [with grain direction alternating in adjacent tiles (basket-weave pattern)] [in pattern of colors and sizes indicated]**.
- C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- D. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

- F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- G. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- F. Premolded Corners: Install premolded corners before installing straight pieces.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.5 RESILIENT ACCESSORY INSTALLATION

- A. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.

3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.6 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

- a. Do not wash surfaces until after time period recommended by manufacturer.

- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Apply protective floor polish to horizontal surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.
 - a. Use commercially available product acceptable to manufacturer.
 - b. Coordinate selection of floor polish with Owner's maintenance service.
2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
3. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 09651

SECTION 09681 - CARPET TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes carpet tile and installation.
- B. Related Sections include the following:
 - 1. Division 9 Section **"Resilient Wall Base and Accessories"** for resilient wall base and accessories installed with carpet tile.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation methods.
- B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge Stripping and Accessory: 12-inch- (300-mm-) long Samples.
- C. Maintenance Data: For carpet tile to include in maintenance manuals specified in Division 1. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Product Options: Products and manufacturers named in Part 2 establish requirements for product quality in terms of appearance, construction, and performance. Other manufacturers' products comparable in quality to named products and complying with requirements may be considered.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

- A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."
- B. Environmental Limitations: Do not install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tile over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tile, install carpet tile before installing these items.

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Carpet Tile Warranty: Written warranty, signed by carpet tile manufacturer agreeing to replace carpet tile that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

- 1. Warranty Period: **10** years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Product: Subject to compliance with requirements, provide the following (or approved equal):
 - 1. See Drawings for Manufacturer and Product, Color, & Pattern.
- B. Yarn System: 100% DuPont Antron Lumena, or approved equal.
- C. Face Construction: **Level-loop pile.**
- D. Tuft Gauge: 1/12
- E. Pile Thickness: .138 inches (3.5 mm) for finished carpet tile per ASTM D 418.
- F. Pile Density: 6,000
- G. Weight Density: 138,000
- H. Backing: **Manufacturer's standard material.**
- I. Performance Characteristics: As follows:
 - 1. Dry Breaking Strength: Not less than 100 lbf (445 N) per ASTM D 2646.
 - 2. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC-165.
 - 3. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per AATCC-16.
 - 4. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC-174.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by carpet tile manufacturer.

- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and that is recommended by carpet tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Verify that substrates and conditions are satisfactory for carpet tile installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 13, "Carpet Modules (Tiles)."

- B. Installation Method: **As recommended in writing by carpet tile manufacturer.**
- C. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- F. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 15, "Protection of Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09681

SECTION 09841 - ACOUSTICAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Acoustical wall panels.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for acoustical wall panels, including plans, elevations, sections, details, and attachments to other Work.
 - 1. Show orientation of fabric application, pattern matching, and seams.
- C. Samples for Verification: 8-by-11-inch (200-by-280-mm) units of each type of acoustical wall panel indicated; in sets for each color, texture, and pattern specified for facing materials, showing the full range of variations expected in these characteristics. Include samples of installation devices and accessories.
- D. Product Certificates: Signed by manufacturers of acoustical wall panels certifying that products furnished comply with requirements.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Product Test Reports: From a qualified testing agency indicating acoustical wall panels comply with requirements, based on comprehensive testing of current products.
- G. Maintenance Data: For acoustical wall panels and facings to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing acoustical wall panels similar to those indicated for this Project and with a record of successful in-service performance.

- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- C. Source Limitations for Acoustical Wall Panels: Obtain acoustical wall panels from one source with resources to provide products of consistent quality in appearance and physical properties.
- D. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify acoustical wall panels with appropriate markings of applicable testing and inspecting agency.
 - 1. Flame Spread: 25 or less.
 - 2. Smoke Developed: 450 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical wall panels from excessive moisture when shipping, storing, and handling. Deliver in unopened bundles and store in a dry place with adequate air circulation. Do not deliver material to building until wet-work, such as concrete and plaster, has been completed and cured to a condition of equilibrium. Protect panel edges from crushing and impact.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical wall panels until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
- C. Field Measurements: Verify wall surface dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish surface dimensions and proceed with fabricating acoustical wall panels without field measurements. Coordinate wall construction to ensure that actual surface dimensions correspond to established dimensions.

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Two years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Wall Panels: Full-size unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated on the drawings.

2.2 ACOUSTICAL WALL PANELS, GENERAL

- A. Fabricate panels to sizes and configurations indicated; attach facing materials to cores to produce installed panels with visible surfaces fully covered and free from waves in fabric weave, wrinkles, sags, blisters, seams, adhesive, or other foreign matter.
1. Fabricate back-mounted panels in factory to exact sizes required to fit wall surfaces, based on field measurements of completed substrates indicated to receive acoustical wall panels.
 2. Where square corners are indicated, tailor corners.
 3. Where radius corners are indicated, attach facing material so there are no seams or gathering of material.
 4. Where fabrics with directional or repeating patterns, or directional weave, are indicated, mark fabric top and attach fabric in same direction.
 5. Where fabric facings with seams are indicated, fabricate invisible seams and comply with Shop Drawings for location.
- B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm) for the following:
1. Thickness.
 2. Edge straightness.
 3. Overall length and width.
 4. Squareness from corner to corner.
 5. Chords, radii, and diameters.
- C. Sound-Absorption Performance: Provide acoustical wall panels with minimum noise reduction coefficients indicated, as determined by testing per ASTM C 423 for mounting type specified.
- D. Back-Mounting Accessories: Manufacturer's standard or recommended accessories for securely mounting panels, of type and size indicated, to substrates provided; and complying with the following requirements:
1. Mechanically Mounted Edge-Reinforced Panels: Metal panel-clip and base-support bracket system consisting of two-part panel clips, with one part of each clip mechanically attached to back of panel and the other part to wall substrate, designed

to support panels laterally; and base-support brackets designed to support full weight of panels; with both designed to allow for panel removal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and blocking, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting acoustical wall panel performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, and scribed to fit adjoining work accurately at borders and at penetrations. Comply with panel manufacturer's written instructions for installation of panels using type of mounting accessories indicated or, if not indicated, as recommended by manufacturer.
- B. Construction Tolerances: As follows:
 - 1. Variation from Plumb and Level: Plus or minus 1/16 inch (1.6 mm).
 - 2. Variation of Joints from Hairline: Not more than 1/16 inch (1.6 mm).

3.3 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.
- C. Remove surplus materials, rubbish, and debris resulting from acoustical wall panel installation, on completion of the Work, and leave areas of installation in a neat and clean condition.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure acoustical wall panels are without damage or deterioration at time of Substantial Completion.
- B. Replace panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 09841

SECTION 09912 - PAINTING (PROFESSIONAL LINE PRODUCTS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of exposed **interior** items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Acoustical wall panels.
 - c. Finished mechanical and electrical equipment (unless noted otherwise on drawings).
 - d. Light fixtures.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Furred areas.
 - b. Ceiling plenums.
 - c. Pipe spaces.
 - d. Duct shafts.

3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- D. Related Sections include the following:
1. Division 6 Section "Interior Architectural Woodwork" for shop priming interior architectural woodwork.
 2. Division 8 Section "Steel Frames" for factory priming steel doors and frames.
 3. Division 9 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.
- E. Alternates: Refer to Division 1 Section "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.4 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
1. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

- B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
 - 1. Provide stepped Samples, defining each separate coat, including fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 - 2. Submit 4 Samples on the following substrates for Architect's review of color and texture only:
 - a. Stained or Natural Wood: **4-by-8-inch (100-by-200-mm)** Samples of natural- or stained-wood finish on representative surfaces.
- C. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain **fillers and primers** for each coating system from the same manufacturer as the finish coats.
- C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
 - 1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall Surfaces: Provide samples on at least **100 sq. ft. (9 sq. m)**.
 - b. Small Areas and Items: Architect will designate items or areas required.
 - 2. Apply permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
 - a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
 - 3. Final approval of colors will be from job applied samples.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).

3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a clean condition, free of foreign materials and residue.
1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.
 2. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
1. Quantity: Furnish Owner with an additional 5 percent, but not less than 1 gal. (3.8 L) or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Manufacturers' Names: Shortened versions of the following manufacturers' names are used in other Part 2 articles:
1. Pratt & Lambert
 2. Sherwin-Williams Co.
 3. Kwal-Howells

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Colors: **As selected by Architect from manufacturer's full range.**

2.3 INTERIOR PRIMERS

- A. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
 - 1. Sherwin-Williams; PrepRite 200 Latex Wall Primer B28W200 Series: Applied at a dry film thickness of not less than **1.6 mils (0.041 mm)**.
- B. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.
 - 1. Sherwin-Williams; Kern Kromik Universal Metal Primer B50NZ6/B50WZ1: Applied at a dry film thickness of not less than **3.0 mils (0.076 mm)**.
- C. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
 - 1. Sherwin-Williams; primer not required over this substrate.
 - 2. Sherwin-Williams; Galvite HS B50WZ30: Applied at a dry film thickness of not less than **3.0 mils (0.076 mm)**.

2.4 INTERIOR FINISH COATS

- A. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.
 - 1. Sherwin-Williams; ProMar 200 Interior Latex Egg-Shell Enamel B20W200 Series: Applied at a dry film thickness of not less than **1.6 mils (0.041 mm)**.
- B. Interior Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.
 - 1. Sherwin-Williams; ProMar 200 Interior Latex Semi-Gloss Enamel B31W200 Series: Applied at a dry film thickness of not less than **1.3 mils (0.033 mm)**.
- C. Interior Full-Gloss Acrylic Enamel: Factory-formulated full-gloss acrylic-latex interior enamel.
 - 1. Sherwin-Williams; ProMar 200 Interior Latex Gloss Enamel B21W201: Applied at a dry film thickness of not less than **1.5 mils (0.038 mm)**.

- D. Interior Semigloss Alkyd Enamel: Factory-formulated semigloss alkyd enamel for interior application.
 - 1. Sherwin-Williams; ProMar 200 Interior Alkyd Semi-Gloss Enamel B34W200 Series: Applied at a dry film thickness of not less than 1.7 mils (0.043 mm).
- E. Interior Full-Gloss Alkyd Enamel for Gypsum Board and Plaster: Factory-formulated full-gloss alkyd interior enamel.
 - 1. Sherwin-Williams; ProMar 200 Alkyd Gloss Enamel B35W200 Series: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).
- F. Interior Full-Gloss Alkyd Enamel for Wood and Metal Surfaces: Factory-formulated full-gloss alkyd interior enamel.
 - 1. Sherwin-Williams; ProMar 200 Alkyd Gloss Enamel B35W200 Series: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).

2.5 INTERIOR WOOD STAINS AND VARNISHES

- A. Open-Grain Wood Filler: Factory-formulated paste wood filler applied at spreading rate recommended by manufacturer.
 - 1. Sherwin-Williams; Sher-Wood Fast-Dry Filler.
 - 2. Sherwin-Williams; none recommended.
- B. Interior Wood Stain: Factory-formulated alkyd-based penetrating wood stain for interior application applied at spreading rate recommended by manufacturer.
 - 1. Sherwin-Williams; Wood Classics Interior Oil Stain A-48 Series.
- C. Clear Sanding Sealer: Factory-formulated fast-drying alkyd-based clear wood sealer applied at spreading rate recommended by manufacturer.
 - 1. Sherwin-Williams; Wood Classics Fast Dry Sanding Sealer B26V43.
- D. Interior Alkyd- or Polyurethane-Based Clear Satin Varnish: Factory-formulated alkyd- or polyurethane-based clear varnish.
 - 1. Sherwin-Williams; Wood Classics Fast Dry Oil Varnish, Satin A66-300 Series.
- E. Interior Waterborne Clear Satin Varnish: Factory-formulated clear satin acrylic-based polyurethane varnish applied at spreading rate recommended by manufacturer.
 - 1. Sherwin-Williams; Wood Classics Waterborne Polyurethane Satin, A68 Series.
- F. Interior Waterborne Clear Gloss Varnish: Factory-formulated clear gloss acrylic-based polyurethane varnish applied at spreading rate recommended by manufacturer.
 - 1. Sherwin-Williams; Wood Classics Waterborne Polyurethane Gloss, A68 Series.
- G. Paste Wax: As recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and reprime.
 - 2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

- b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
 - 3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - c. If transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
 - 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to [SSPC-SP 6/NACE No. 3] [SSPC-SP 10/NACE No. 2].
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
 - 5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 10. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a

- smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- F. Electrical items to be painted include, but are not limited to, the following:
1. Switchgear.
 2. Panelboards.
 3. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- G. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

- I. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
 - 1. Provide satin finish for final coats.
- J. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.5 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 INTERIOR PAINT SCHEDULE

- A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Satin Acrylic-Enamel Finish: **Two finish coats** over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
- B. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Semigloss Alkyd-Enamel Finish: **Two finish coats** over a primer.
 - a. Primer: Interior ferrous-metal primer.
 - b. Finish Coats: Interior semigloss alkyd enamel.
- C. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
 1. Semigloss Alkyd-Enamel Finish: **Two finish coats** over a primer.
 - a. Primer: Interior zinc-coated metal primer.
 - b. Finish Coats: Interior semigloss alkyd enamel.

3.7 INTERIOR STAIN AND NATURAL-FINISH WOODWORK SCHEDULE

- A. Stained Woodwork: Provide the following stained finishes over new interior woodwork:
 1. Stain Satin-Varnish Finish: **Two** finish coats of alkyd-based clear satin varnish over a sealer coat and interior wood stain. Wipe wood filler before applying stain.
 - a. Filler Coat: Open-grain wood filler.
 - b. Stain Coat: Interior wood stain.
 - c. Sealer Coat: Clear sanding sealer.
 - d. Finish Coats: Interior clear satin varnish.
- B. Natural-Finish Woodwork: Provide the following natural finishes over new interior woodwork:
 1. Satin-Varnish Finish: **Two** finish coats of alkyd-based clear satin varnish over a sanding sealer. Provide wood filler on open-grain wood before applying first varnish coat.
 - a. Filler Coat: Open-grain wood filler.
 - b. Sealer Coat: Clear sanding sealer.
 - c. Finish Coats: Interior clear satin varnish.

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SECTION 10801 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Toilet and bath accessories.
- B. Related Sections include the following:
 - 2. Division 10 Section "Toilet Compartments" for compartments and screens.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.
- C. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.
- B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.

1. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
 1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering accessories that may be incorporated into the Work include, but are not limited to, the following:
 1. Toilet and Bath Accessories:
 - a. American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.

2.2 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch (0.9-mm) minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).
- D. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
- E. Baked-Enamel Finish: Factory-applied, gloss-white, baked-acrylic-enamel coating.
- F. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.
- G. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- H. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION

- A. General: Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.
- C. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.
- D. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.
 - 1. Provide galvanized steel backing sheet, not less than 0.034 inch (0.85 mm) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

- E. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:
 - 1. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - 2. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
- F. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.
- C. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10801

SECTION 12491 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of venetian blinds and accessories:
 - 1. **Miniblinds** with aluminum louver slats.

1.3 DEFINITIONS

- A. Miniblind: Venetian blind with nominal **1-inch- (25-mm-)** wide louver slat.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
- B. Shop Drawings: Show location and extent of horizontal louver blinds. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other Work, operational clearances, and relationship to adjoining work.
- C. Samples for Initial Selection: For each colored component of each type of horizontal louver blind indicated.
 - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For the following products, prepared on Samples from the same material to be used for the Work.
 - 1. Louver Slat: Not less than **12 inches (300 mm)** long.
 - 2. Horizontal Louver Blind: Full-size unit, not less than **16 inches (400 mm)** wide by **24 inches (600 mm)** long.
 - 3. Valance: Full-size unit, not less than **12 inches (300 mm)** wide.
- E. Window Treatment Schedule: Include horizontal louver blinds in schedule using same room designations indicated on Drawings.

- F. Product Certificates: For each type of horizontal louver blind product, signed by product manufacturer.
- G. Product Test Reports: For each type of horizontal louver blind product.
- H. Maintenance Data: For horizontal louver blinds to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining horizontal louver blinds and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to finishes and performance.
 - 3. Operating hardware.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain horizontal louver blinds through one source from a single manufacturer.
- B. Corded Window Covering Product Standard: Provide horizontal louver blinds complying with WCMA A 100.1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver blinds in factory packages, marked with manufacturer and product name, **lead-free designation**, and location of installation using same room designations indicated on Drawings and in a window treatment schedule.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Horizontal Louver Blinds: Before installation begins, for each size, color, texture, pattern, and gloss indicated, full-size units equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Horizontal Louver Blinds, Aluminum Louver Slats:
 - a. Springs Window Fashions Division, Inc.; Bali.

2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM LOUVER SLATS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 1. See Drawings.
- B. Louver Slats: 5086H19 cold rolled aluminum .008 inch thick, alloy and temper recommended by producer for type of use and finish indicated; with crowned profile **and radiused corners**.
 1. Nominal Slat Width: **1 inch (25 mm)** for miniblinds.
 - a. Slat Spacing: **Not less than every 20 mm for 15.2 slats or more per foot (20 mm)**.
 2. Slat Finish: One color as indicated.
 - a. Ionized Coating: Antistatic, dust-repellent, baked polyester finish.
- C. Headrail/Valance: Decorative, integrated headrail/valance not requiring a separate valance or end brackets for finished appearance; formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends; capacity for several blinds per headrail, unless otherwise indicated.
 1. Finish Color Characteristics: **Color texture, pattern, and gloss as selected by Architect from manufacturer's full range.**
- D. Bottom Rail: Formed-steel or extruded-aluminum tube, sealed with plastic or metal capped ends, fully enclosed, **bottom contoured for minimizing light gaps**; with enclosed and protected ladders and tapes to prevent their contact with sill.
- E. Maximum Light Blocking Blinds: Designed for eliminating all visible light gaps if slats are tilted closed; with tight tape spacing indicated and slats with minimal-sized rout

holes for ladders hidden and placed near back edge for maximum slat overlap; with headrail and bottom rail extended and formed for light-tight joints between rail and adjacent slats or construction.

- F. Tilt Control: Consisting of enclosed worm gear mechanism, **slip clutch or detachable wand preventing overrotation**, and linkage rod, for the following operation:
 - 1. Tilt Operation: Manual with **clear plastic wand**.
 - 2. Length of Tilt Control: **Full length of blind**.
 - 3. Tilt: Two-direction, positive stop or lock out limited at an angle of **60** degrees from zero-degree horizontal, both directions.
- G. Lift Operation: Manual, cord lock; locks pull cord to stop blind at any position in ascending or descending travel.
- H. Tilt-Control and Cord-Lock Position: **Right side and left side of headrail, respectively** unless otherwise indicated.
- I. Ladders: Evenly spaced to prevent long-term louver sag.
 - 1. For Blinds with Nominal Slat Width **1 Inch (25 mm)** or Less: Braided polyester string.
- J. Mounting: Mounting permitting easy removal and replacement without damaging blind or adjacent surfaces and finishes; with spacers and shims required for blind placement and alignment indicated.
 - 1. Provide intermediate support brackets if end support spacing exceeds spacing recommended by manufacturer for weight and size of blind.
- K. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard, as indicated.
- L. Side Channels and Perimeter Seals: Manufacturer's standard for eliminating light gaps when blinds are closed.
- M. Colors, Textures, Patterns, and Gloss: **As selected by Architect from manufacturer's full range**.

2.3 HORIZONTAL LOUVER BLINDS FABRICATION

- A. Product Standard and Description: Comply with AWCMA Document 1029, unless otherwise indicated, for each horizontal louver blind designed to be self-leveling and consisting of louver slats, rails, ladders, tapes, lifting and tilting mechanisms, cord, cord lock, tilt control, and installation hardware.
- B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
 - 1. Lifting and Tilting Mechanisms: With permanently lubricated moving parts.

- C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 - 1. Blind Units Installed between (Inside) Jambs: Width equal to 1/4 inch (6 mm) per side or 1/2 inch (12 mm) total, plus or minus 1/8 inch (3 mm), less than jamb-to-jamb dimension of opening in which each blind is installed. Length equal to 1/4 inch (6 mm), plus or minus 1/8 inch (3 mm), less than head-to-sill dimension of opening in which each blind is installed.
 - 2. Blind Units Installed Outside Jambs: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- D. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail and operating hardware, and for hardware position and blind mounting method indicated.
- E. Installation Fasteners: Not fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
- F. Color-Coated Finish:
 - 1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
- G. Component Color: Provide rails, cords, ladders, and exposed-to-view metal and plastic matching or coordinating with slat color, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HORIZONTAL LOUVER BLIND INSTALLATION

- A. Install blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior louver edges in any position are not closer than 1 inch (25 mm) to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware, if any.

- B. Flush Mounted: Install blinds with louver edges flush with finish face of opening if slats are tilted open.
- C. Jamb Mounted: Install headrail flush with face of opening jamb and head.
- D. Head Mounted: Install headrail on face of opening head.

3.3 ADJUSTING

- A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean blind surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged blinds that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 12491

DIVISION 15
MECHANICAL SPECIFICATION

15000 GENERAL

15010 GENERAL REQUIREMENTS

15050 BASIC MATERIALS AND METHODS

15051 BASIC MATERIALS AND METHODS GENERAL REQUIREMENTS

15070 VIBRATION, NOISE CONTROL AND SEISMIC PROTECTION

15075 PIPE AND EQUIPMENT IDENTIFICATION

15080 MECHANICAL INSULATION

15081 DUCT INSULATION

15083 CULINARY WATER PIPE INSULATION

15087 REFRIGERATION PIPE INSULATION

15100 BUILDING SERVICES PIPING

15101 PIPE AND PIPE FITTINGS

15140 HOT AND COLD WATER SYSTEMS

15150 SOIL WASTE AND VENT PIPING

15181 CONDENSATE DRAIN PIPING

15184 REFRIGERANT PIPING AND SPECIALTIES

15400 PLUMBING FIXTURES AND EQUIPMENT

15410 PLUMBING FIXTURES

15416 DRINKING WATER COOLING SYSTEM

15700 HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

15735 COMPUTER ROOM UNIT

15800 AIR DISTRIBUTION

15801 GENERAL DUCT REQUIREMENTS

15812 ROUND STEEL DUCTWORK

15813 MEDIUM VELOCITY DUCTWORK

15816 RECTANGULAR STEEL DUCKWORK

15818 FLEXIBLE DUCT

15819 DUCTWORK TESTING

15820 DUCT ACCESSORIES

15821 FIRE AND SMOKE DAMPERS

15822 DUCT LINER

15836 EXHAUST FANS

15840 TERMINAL AIR UNIT

15851 DIFFUSERS, REGISTERS, AND GRILLES

15900 HVAC INSTRUMENTATION AND CONTROLS

15910 DDC CONTROL SYSTEM

15920 PNEUMATIC CONTROL SYSTEM

15940 SEQUENCE OF CONTROLS

15950 TESTING, ADJUSTING AND BALANCING

15960 AIR SYSTEM TEST AND BALANCE

15990 FINAL TEST RUN

SECTION 15010 - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL:

- A. General Conditions and Division 01 apply to this Division.

1.2 SCOPE:

- A. Includes -
 - 1. Furnish all labor, materials, and equipment necessary for completion of the mechanical work for the University of Utah College of Nursing 5th floor west renovation, University of Utah campus, Salt Lake City, Utah.
 - 2. Furnish and install all motors specified in this Division and be responsible for the proper operation of electrical powered equipment furnished by this Division.
 - 3. Furnish exact location of electrical connections and information on motor controls to Division 16.
 - 4. Placing the air conditioning, heating, ventilating, and exhaust systems into full operation and continuing their operation during each working day of testing and balancing.
 - 5. Making changes in pulleys, belts, and dampers, or adding dampers, as required for the correct balance as recommended by Balancing Contractor at no additional cost to Owner.
 - 6. Air balance, final adjustment and test run.
 - 7. The satisfactory performance of the completed systems is a requirement of this specification.
- B. Related Work Specified Elsewhere -
 - 1. Conduit and wiring for line voltage, outlets, and disconnect switches specified in Division 16.
 - 2. Magnetic starters and thermal protective devices (heaters) not a factory mounted integral part of packaged equipment are specified in Division 16.

1.3 SITE INSPECTION:

- A. The Contractor shall examine the site and understand the conditions which may affect the performance of work of this Division before submitting proposals for this work.
- B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

1.4 DRAWINGS:

- A. Mechanical drawings show general arrangement of piping, ductwork, equipment, etc; however, locations are to be regarded as shown diagrammatically only. Follow as closely as actual building construction and work of other trades will permit.

- B. Because of the small scale of mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate existing structural and finished conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- C. If changes in location of piping, equipment, ducts, etc. are required due to lack of coordination of work under this division, such changes shall be made without charge. Contractor shall review drawings with local and state agencies having jurisdiction and any changes required by them shall be brought to the attention of the Architect prior to bidding or commencement of work.

1.5 CODE REQUIREMENTS, FEES, AND PERMITS:

- A. The work shall be installed in accordance with the following applicable codes, ordinances and standards unless otherwise specified. The codes and standards shall include but not be limited to and be of the latest and current editions.
 - 1. Air Movement and Control Association (AMCA)
 - 2. American National Standards Institute (ANSI)
 - 3. Air Conditioning & Refrigeration Institute (ARI)
 - 4. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - 5. American Society of Mechanical Engineers (ASME)
 - 6. American Society of Testing Materials (ASTM)
 - 7. American Standards Association (ASA)
 - 8. American Water Works Association (AWWA)
 - 9. American Welding Society (AWS)
 - 10. Associated Air Balance Council (AABC)
 - 11. National Electrical Code (NEC)
 - 12. National Fire Protection Association (NFPA)
 - 13. Sheet Metal and Air Conditioning contractors National Association (SMACNA)
 - 14. Underwriters Laboratories (UL)
 - 15. International Building Code (IBC)
 - 16. International Mechanical Code (IMC)
 - 17. International Plumbing Code (IPC) with Utah Amendments
 - 18. Utah State Safety Orders (OSHA/UOSH)
 - 19. Utah Fire Rating Bureau
 - 20. Utah Air Conservation Regulations/Waste Disposal regulations.
 - 21. ASHRAE Ventilation STD.62.1-2001
 - 22. Energy Code for Commercial and High Rise Building ASHRAE/IESNA 90.1 - 1999
 - 23. University of Utah Design Standards
- B. Should drawings conflict with any code, the code shall govern. If drawings and specifications establish a quality exceeding the code, the drawings and specifications shall govern. If conflicts do exist among the drawings,

specifications and codes, the same shall be brought to the attention of the Architect in writing prior to bidding, otherwise Contractor shall comply with applicable codes.

- C. The latest edition of all codes shall be used.
- D. Contractor shall give all notices, obtain all necessary permits, file necessary plans, prepare documents and obtain approvals, and pay all fees required for completion of the mechanical and plumbing work outlined in this Division of the specifications and shown on the Mechanical Drawings.

1.6 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS:

- A. Upon completion of work and before final payment, Contractor shall furnish and deliver to the University, through the Architect, three (3) sets of installation, operating and maintenance manuals and instructions for all new materials and mechanical equipment used in the building.
- B. Bind Operation and Maintenance Manual for Mechanical Systems in a hard-backed piano hinge loose-leaf binder with strong sturdy cover. The following lettering shall be stamped on front and spine of each binder:

OPERATION
AND
MAINTENANCE
MANUAL
for MECHANICAL SYSTEMS of
(Name of Project)
(Location of Project)
(Name of Architect)

- C. The first section is to contain the following information.
 - 1. First page shall be a table of contents including name of project, date awarded and date of substantial completion.
 - 2. Second page shall contain the names, phone numbers and addresses of Architect, Consulting Engineers, and Associates.
 - 3. Third page shall contain a list of names, addresses and phone numbers of contractors and all sub-contractors and work to which each was assigned.
 - 4. Final page or pages shall contain an equipment list. The list shall contain each item of equipment or material for which a submittal was required giving ID or tag no as contained on the drawings make and model No. Serial No. Identification No. Location in building, function and name address and phone number of supplier.
- D. The second section shall contain
 - 1. Description of each operating system included location of switches, breakers thermostats control devices. Provide a single line diagram, showing set points, normal operating parameters for all loads, pressures, temperatures and flow check points; Describe all alarms and cautions for operation.
 - 2. Provide schematic control diagrams, panel diagrams, wiring diagrams etc (blue line prints) for each separate fan system, chilled water system, hot water system, exhaust air system, pumps, etc. each control diagram shall

- show a schematic representation of mechanical equipment and location of start-stop switches, insertion thermostats, thermometers, pressure gauges, automatic valves etc. The correct reading for each control instrument shall be marked on the diagram.
- E. The third section shall contain a comprehensive lubrication list and maintenance schedule for equipment with moving parts. If bearings are sealed equipment shall still be included and a statement to indicate no lubrication or maintenance required.
 - F. The fourth section shall contain a complete air test and balance report. The report shall contain name, address and phone number of agency. Name and certification of their mechanical engineer, list of equipment with date of last calibration.
 - 1. Floor plans showing all air openings and thermometer location clearly marked and cross reference with data sheets. Formatted may be 8 1/2 x 11 or 11x14 if legible.
 - 2. Data sheets showing amount of air handled at each setting see section 15960 and 15970.
 - G. The fifth section shall contain data on plumbing fixtures and equipment.
 - 1. Section shall contain general product catalog cuts, approved submittal sheets and exploded view drawings with parts lists for all valves and other items with multiple parts.
 - H. The final sections shall be one for each individual item for which a submittal sheet was required. Each section shall include:
 - 1. Equipment descriptions
 - 2. Detailed installation instruction, operating and maintenance instructions (provided more than just product operations and maintenance instructions provided with unit where required. Instructions should be written in a step by step manner identifying start-up, operating, shutdown and emergency action sequence sufficiently clear so a person unfamiliar with the equipment could perform its operations.
 - 3. Equipment drawings, performance curves, operating characteristics, etc.
 - 4. Name addresses and phone number of manufacturer, fabricator and local vender clearly printed or stamped on cover.
 - 5. Complete parts listing which include catalog number, serial number, contract number or other accurate provision for ordering replacement and spare parts.
 - 6. Certified drawings, where applicable, showing assembly of parts and general dimensions.
 - 7. General product and approved submittal sheets
 - I. Equipment to be covered:
 - 1. Mechanical equipment
 - 2. Plumbing fixtures and equipment.
 - 3. Automatic controls and sensing systems
 - 4. Any item for which a submittal is required.

1.7 OPERATION AND MAINTENANCE INSTRUCTIONS:

- A. Contractor shall instruct representatives of Campus Planning Systems

Operations and other building maintenance personnel in the operation and maintenance of the installed mechanical systems utilizing the Operation and Maintenance Manual when so doing.

- B. Minimum instruction periods shall be as follows -
 - 1. Mechanical - Four hours.
 - 2. Plumbing - Two hours
 - 3. Temperature Control Two hours.
- C. Instruction periods shall occur before final inspection when systems are properly working and before final payment is made.
- D. None of these instructional periods shall overlap each other.
- E. An additional one hour of instruction will be provided by each contractor, after 60 days of system operation by owner to insure proper system operation and answer questions.

1.8 RECORD DRAWINGS:

- A. Contractor shall keep an up-to-date set of mechanical and plumbing drawings in his custody showing all changes in red, clearly defined and neatly drafted by him. At the end of construction, he shall turn these drawings over to the Architect. Record drawings must be completed and submitted prior to final inspection.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION 15010

SECTION 15051 - BASIC MATERIALS & METHODS GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL:

- A. Division 15010 General applies to this Section.

1.2 COORDINATION OF WORK:

- A. It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for the installation of systems according to the true intent and meaning of the Contract Documents. Anything not clear or in conflict will be explained by making application to the Architect in writing. Should conditions arise where certain changes would be advisable, secure Owner's and Architect approval for these changes before proceeding with work.
- B. Coordinate work of various trades in installing interrelated work. Before installation of mechanical items, make proper provision to avoid interferences in a manner approved by Architect. Changes required in work specified in Division 15 caused by neglect to secure approval shall be made at no cost to Owner.
- C. Arrange piping, ductwork, and equipment to permit ready access to valves, unions, starters, motors, control components, and to clear openings of doors and access panels. Contractor shall provide all necessary access doors and/or panels to provide complete access to all mechanical equipment, dampers, or accessories. Doors for dampers, etc. shall be minimum 12" x 12" and doors for mechanical equipment shall be minimum 24" x 24".
- D. Furnish and install inserts and supports required by Division 15 unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions involved in sufficient time to be built into the construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne by Contractor.
- E. Be responsible for required digging, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of Owner and Architect. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.
 - 1. Patch and repair walls, floors and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
 - 2. This Division shall bear expense of cutting, patching, repairing, and replacing of work of other Divisions because of its fault, error, tardiness, or because of damage done by it.
 - 3. Provide the necessary cutting, patching, repairing, and replacing pavements, sidewalks, etc. to permit installation of work of this Division.
- F. Adjust locations of piping, ductwork, equipment, etc. to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and cut prior to fabrication.

1. Make offsets, transitions, and changes in direction of piping, ductwork, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
- G. Slots and openings through floors, walls and roofs shall be provided by this Division.
- H. This Contractor shall schedule his work, store his equipment and materials, and work in harmony with other Contractors so as to not delay or jeopardize the construction.
- I. This Division shall coordinate with electrical contractor to insure that all required components of control work are included and fully understood. Any discrepancies shall be called to the attention of the Architect before completion of bids. No additional cost shall accrue to the Owner as a result of lack of such coordination.

1.3 EQUIPMENT & MATERIALS:

- A. Requests for substitution shall be received in writing a minimum of seven days prior to bidding. Prior acceptance shall be by Manufacturer's name only. Items not listed in this specification or subsequent addendums shall not be considered. No oral approvals will be acceptable. Manufacturers listed in this specification are acceptable only for items listed. All other items manufacturer wishes to bid must be prior approved. All equipment shall be subject to final review in accordance with "Project Submittals".
- B. Product Approvals -
 1. If approval is received to use other than specified items, responsibility for specified capacities and insuring that items to be furnished will fit space available lies with this Division.
 2. In the event other than specified equipment is used and will not fit job site conditions, this Division assumes responsibility for replacement with items named in Specification.
- C. Use domestic made pipe, pipe fittings, and motors on Project.
- D. Motor and equipment name plates as well as applicable UL labels shall be in place when Project is turned over to Owner.
- E. Insure that items to be furnished fit spaces available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. Do not scale off drawings.
- F. All materials shall be of the best commercial quality obtainable, consistent with specified materials and for the purpose or function intended. Materials shall be new unless specifically excepted.
- G. Equipment catalog or model numbers shown define the basic equipment types and quality standard only. Catalog numbers shall not be considered as all inclusive and shall be verified to include all devices, controls, operators, and appurtenances necessary for the satisfactory and complete operation of the equipment.
- H. Follow manufacturer's directions in delivery, storage, protection, and installation of equipment and materials.
 1. Promptly notify Architect in writing of conflicts between requirements of

Contract Documents and Manufacturer's directions and obtain Architect's written instructions before proceeding with work. Contractor shall bear all expenses arising from correcting deficiencies of work that does not comply with Manufacturer's directions or such written instructions from Architect.

- I. Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or mechanical injury but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in a dry, heated space.

1.4 PROJECT SUBMITTALS:

- A. Furnish complete catalog data for manufactured items of equipment to be used in the Work to Architect for review within 15 days after award of Contract.
- B. Submittal shall include, but not be limited to the following:
 - 1. equipment scheduled
 - 2. balancing contractor
 - 3. insulation
 - 4. grilles, and diffusers
 - 5. automatic temperature controls
 - 6. certificates of guarantee
 - 7. valves
 - 8. plumbing fixtures, accessories, and specialties
 - 9. any item for which more than one manufacturer is mentioned
- C. Submit a minimum of five copies of data in binders and index in same order and name as they appear in Specification.
 - 1. State sizes, capacities, brand names, motor HP, electrical requirements, accessories, materials, gauges, dimensions, and other pertinent information.
 - 2. List on catalog covers page numbers of submitted items.
 - 3. Underline or highlight applicable data.
- D. If material or equipment is not as specified or submittal is not complete, it will be rejected.
- E. Catalog data or shop drawings for equipment which are noted as being reviewed by Architect shall not supercede Contract Documents.
- F. Review comments of Architect shall not relieve this Division from responsibility for deviations from Contract Documents unless Architect's attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.
- G. Check work described by catalog data with Contract Documents for deviations and errors.
- H. All items other than first named specified equipment shall show and state all exceptions and deviations taken and shall include design calculations and drawing layouts.
- I. The Contractor shall review the submittals prior to submission to the Architect to make sure that the submittals are complete in all details. No submittal will be reviewed which does not bear the contractor's notation that such checking has been made.

- J. No partial submittals will be considered unless approved by the Architect's engineer.
- K. Manufacturers' names shall be mentioned as acceptable prior to bidding. See paragraph 3a above.
- L. Contractor shall verify equipment dimensions to fit the spaces provided with sufficient clearance for servicing the equipment.
- M. Contractor shall review equipment submittals for compliance with schedules, specifications, and drawing plans and details. Equipment submittal shall show the proper arrangements to suit installation and maintenance such as motor location, access doors, filter removal, piping connections, etc.
- N. Equipment submittal sheets shall be clearly marked indicating equipment symbol and exact selection of proposed equipment. Submittals shall clearly indicate name of manufacturer of each item.
- O. For unacceptable items, the right shall be reserved to require the first named specified items.
- P. Where submittals are sent to Architect with any of the above listed information missing or are incomplete they will be returned to the contractor unchecked to be completed and resubmitted. No additional time or money shall be allowed for failure to provide complete submittals on the first review.
- Q. If an item requiring submittal review is ordered, purchased, shipped, or installed prior to the submittal review and is subsequently disapproved the item shall be removed from the job site and replaced with an approved item at contractors expense.

1.5 CLEANING & FINISHING:

- A. Contractor shall, at all times, keep the premises free from waste material and rubbish. Upon completion of this Section of the work, Contractor shall remove all surplus materials and rubbish; clean all spots resulting from the mechanical work from hardware, floors, glass, walls, etc.; do all required patching up and repair all work of other trades damaged by Contractor under this Section of the work, and leave the premises in a clean orderly condition. Clean heating and cooling coils, internally and externally, and replace all air filters prior to final mechanical inspection. Remove rust, plaster, dirt, grease and oil before painting, insulating, or exposing to view the equipment, piping, ductwork, etc. in completed structure. Refinish any damaged surfaces and leave in proper working order at final completion.

1.6 EQUIPMENT SERVICING:

- A. Prior to starting mechanical equipment, all motors, bearings and moving parts shall be properly oiled, greased and lubricated as required. Full and adequate maintenance service shall be given and upon completion all equipment shall be cleaned and checked and placed in perfect condition for the Owner.
- B. Provide lubrication for the following:
 - 1. Exhaust fans
 - 2. Damper motors
 - 3. Dual Duct boxes

- 4. Computer Room Unit
- C. Amount and type of lubricant shall be per manufacturer's specification.

1.7 SUPERVISION:

- A. The Contractor shall supervise and direct the work with his best skill and attention. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The Contractor will be responsible to see that the finished work complies accurately with the Contract Documents.

1.8 SAFETY REGULATIONS:

- A. Contractor shall provide equipment, supervision, construction, procedures, and everything necessary to assure safety of life or property.
- B. Refer also to General Condition and Special Conditions for protection clauses.

1.9 LEAK DAMAGE:

- A. Contractor shall be responsible for damages to the work of other Contractors or to the building, or to its contents, people, etc., caused by leaks in any of the equipment or piping installed by him through equipment or material failures, leaking joints or disconnected pipes, fittings, or by overflows and shall make at his own expense all repairs to fixtures, building interior, contents, paint, rugs, furniture, ceiling tile, and equipment so damaged.

1.10 TOOLS AND STORAGE OF EQUIPMENT:

- A. The Contractor shall furnish all necessary tools, staging and whatever may be necessary for the installation of this work and shall at all times protect this work and others, and the materials to be used therein from damage by the weather, accident and other causes, and shall repair and make good any damage thus occurring.

1.11 WORKMANSHIP:

- A. Workmanship shall be the best quality of its kind for respective industries, trades, crafts and practices and shall be acceptable in every respect to the Owner and Architect. Nothing contained herein shall relieve the Contractor from performing good work, perfect in all details of construction.

1.12 TEMPORARY FACILITIES:

- A. Furnishing of temporary water, space heating, sanitary facilities, drainage lines, light and power will be as specified in Division 01 General Conditions. Contractor shall arrange to bring facilities to required location of premises. All expenses involved shall be paid by the Contractor as described in General and Special Conditions.

1.13 PAINTING BY CONTRACTOR:

- A. See section 09900 for painting requirements. See also section 15075 for color code requirements.
- B. Painting shall be by persons experienced in painting.
- C. All exposed, insulated, and bare piping, equipment, metal stands and supports shall be painted as follows:
 - 1. All equipment which is to be furnished in finished painted condition by Contractor shall be left without mark, scratch or impairment to finish upon completion and acceptance of job. Any necessary refinishing to match original shall be done by Contractor. Do not paint over name plates, serial numbers or other identifying marks.
 - 2. All new piping shall be painted as required in Section 15075. Paint colors shall conform to color code requirements as specified in 15075 "Identification of Piping and Equipment"

1.14 ELECTRICAL WORK:

- A. Power wiring to all electrically driven apparatus shall be done under the electrical contract. See Electrical Specifications.
- B. Unless specifically noted otherwise on documents, Electrical Contractor shall furnish and install all magnetic starters including properly sized heaters, and disconnect switches as indicated on drawings or required by code.
- C. The Contractor shall verify the proper operation of equipment furnished by him. Costs for repair, replacing, re-wiring and retesting shall be borne by the Contractor without additional costs to the Owner.

1.15 CONTRACTOR'S USE OF BUILDING EQUIPMENT:

- A. The Contractor may use equipment such as electric motors, fans, filters, etc. when permanently installed as part of the project and with the written permission of the Owner. As each piece of equipment is used, maintenance procedures approved by the manufacturer shall be followed, a careful record shall be kept of the time used, maintenance procedure following and of any difficulty experienced with equipment. The Contractor's records on the equipment shall be submitted to the Owner upon acceptance of project. All fan belts and filter media shall be new at the beginning of the Mechanical System Operating Test Run and System Balancing. Wearing surfaces (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement.

1.16 INSPECTION NOTICE:

- A. The following is a basic list of guideline items so that the Architect, district building inspector/Owner's representative can be at job site for these inspections as the building progresses. Mechanical Contractor shall inform these people one week in advance of test time.
 - 1. Water tests on all sewer and waste piping prior to piping being concealed.
 - 2. Pressure tests on all water service piping.

3. All duct work prior to installation of finished ceilings, including ductwork pressure testing.
4. The initial start-up of mechanical equipment, etc.
5. Any changes or problems occurring at job site.
6. Inspect all vent flashings on roof prior to roofing.
7. Periodic inspection at their discretion will be made to insure compliance to Contract Documents and codes. Contractor shall provide ladders, access and other assistance as requested during inspections.
8. Control piping pressure tests.
9. Final inspection before giving approval for final payment.

1.17 WARRANTY GUARANTEE:

- A. The Contractor shall warrant all materials and equipment to be of quality consistent with specifications as represented by manufacturer's published data.
- B. The Contractor shall guarantee that the installation and operation of the equipment shall be free from defects for a period of one year beginning at date of substantial completion and acceptance. The Contractor shall replace or repair any part of the installation that is found to be defective or incomplete within the guarantee period.
- C. The one year guarantee on equipment and systems shall commence when equipment has been demonstrated to work and has been accepted. (Example: If an equipment item fails to perform and it takes 9 months after substantial completion to correct, then the guarantee shall commence after the item has been demonstrated to perform and has been accepted.)
- D. Substantial completion and acceptance in no way relieves the Contractor from providing the systems and equipment as specified.

1.18 COMPLETION SCHEDULE:

- A. Start-up and verification of basic equipment items shall be done prior to the date of substantial completion with sufficient time to allow balancing and adjusting to be performed.
- B. At the time of the final inspection a date shall be agreed upon for completion of any remaining items. At least double the estimated cost of the work will be withheld from the Contractor's payment.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION 15051

SECTION 15070 - VIBRATION, NOISE CONTROL, AND SEISMIC PROTECTION

PART 1 - GENERAL

1.1 REQUIREMENTS:

- A. The General Provision of the Contract, including General and Supplementary Conditions and General Requirements apply to the work specified in this section.
- B. Requirements of Section 15010 apply to this section.
- C. Requirements of Section 15051 apply to this section.

1.2 SCOPE:

- A. The scope of work shall include all labor, material, and equipment necessary for a complete anchorage and seismic restraint system and vibration isolation for all work included as part of Division 15. The other system design and installation shall be based on Seismic Zone III of the Uniform Building Code, F values from International Building Code for project location, and other standards listed below.
- B. The work shall include all mechanical isolated and non-isolated equipment, ducts and piping systems.
- C. This section is general and only those items that apply to work of this project are required.

1.3 REFERENCE STANDARDS:

- A. International Building Code (IBC)
- B. NFPA Bulletin 90A, Current Edition
- C. UL Standard 181
- D. Tri-Services Manual, Fagel Et Al, 1973
- E. SMACNA Guidelines for Seismic Restraints of Mechanical Systems
- F. ASHRAE - American Society of Heating, Ventilating and Air Conditioning Engineers.

1.4 SEISMIC REQUIREMENTS AND QUALIFICATIONS

- A. The Mechanical Contractor shall be responsible for supplying and installing equipment, vibration isolators, flexible connections, rigid steel frames, anchors, inserts, hangers and attachment, supports, seismic snubbers and bracing to comply with the International Building Code (IBC).
- B. All supports, hangers, bases, braces and anchorage for all non-isolated equipment, and piping shall be installed as detailed and specified in the contract documents. Specific requirements on the equipment anchorage and restraints, locations and sizes shall be furnished by the contractor and submitted to the Architect for review after shop drawings for mechanical equipment have been reviewed.
- C. All supports, hangers, bases, anchorage and bracing for all isolated equipment shall be designed by a professional engineer employed by the restraint manufacturer, qualified with seismic experience in bracing for mechanical

equipment. Shop drawing submitted for earthquake bracing and anchors shall bear the Seismic Engineer's signed professional seal. Seismic Engineer shall be licensed in the state of Utah.

- D. The Contractor shall require all equipment suppliers to furnish equipment that meets the seismic code, with bases designed to receive seismic bracing and/or anchorage. All isolated mechanical equipment bracing to be used in the project shall be designed from the Equipment Shop Drawings certified correct by the equipment manufacturer for Seismic Zone III.
- E. Manufacturers and suppliers of restraint equipment and systems approved for use by the Contractor, for isolated and non-isolated systems, are Mason Industries, Inc., Korfund, Amber/Booth Company, Vibration Mountings & Control Co. Manufacturer of seismic restraint equipment and the vibration isolators for isolated equipment shall be the same manufacturer.
- F. The approved manufacturer or supplier shall be totally responsible for the design, fabrication, installation and operation of the vibration and seismic bracing system specified.

1.5 SUBMITTALS

- A. Submit product data in accordance with Division 1 and section 15010. Submit the following:
 - 1. Restraint system and anchorage method to be used for each piece of equipment.
 - 2. Shop drawings showing size, hanger length, and the location of all seismic restraints for piping and ductwork.
 - 3. Seismic restraints and calculations for all flexible mounted equipment.
 - 4. Vibration isolators and flexible couplings.
 - 5. Details for all the isolators and seismic bracing with snubbers proposed for items in this specification and on the Drawings.
 - 6. Details for steel frames, concrete inertia bases, and anchors to be used in conjunction with the isolation of the items in the specification and drawings.
 - 7. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing anchors and snubbers.

PART 2 - PRODUCTS

2.1 VIBRATION AND NOISE CONTROL:

- A. All mechanical equipment 1 horse power and larger, unless otherwise noted shall be isolated from building structure. Equipment connected to piping, ductwork, roof, wall or overhead structure of building shall have flexible connections to prevent the transmission of vibration and mechanically transmitted sound to the building structure.
- B. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflection. Deflection recommendations shall be noted in submittal. Submittal shall include spring metal diameters, deflections, unloaded spring height, loaded spring height, solid spring height, clearance

- around housing and restraining bolts.
- C. Fans shall be mounted on rail-type isolating bases providing support and adjustment for belt center distance between motor and fan. Use steel spring isolators with air handling units. Mason type SLC spring and neoprene pad mounts.
 - D. Steel Spring Isolators: Shall be free standing open coil type, rated for 95% efficiency or show 2" static deflection. All dimensionally stable; that is, loaded height shall be equal to spring diameter.
 - E. Duct connections to all equipment shall be made with 3" fabric connector made for the purpose intended. Fabric shall be as per section 15820.
 - F. Isolating hangers shall be open coil combination steel spring and neoprene in shear with deflection indication. Springs shall be selected for 95% efficiency. Mason Type TDNHS.
 - G. Vibration Isolators
 - 1. General Properties
 - a. All vibration isolators shall have either known undeflected heights or other markings so that, after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.
 - b. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of 50% above the design deflections.
 - c. The ratio of lateral to vertical stiffness shall not be less than 1.0 or greater than + or - 10%.
 - d. Water motion through the isolator shall be reduced to the following extent: Isolation above the resonant frequency shall follow the theoretical prediction based upon an undamped single degree of freedom system, with a minimum isolation of 50 decibels above 150 cycles per second.
 - e. All neoprene mounting shall have a shore hardness of 50 to 60 after minimum aging of 20 days or corresponding over aging.

2.2 SEISMIC RESTRAINTS:

- A. General Requirements: Seismic restraints shall be provided for all vibration isolated equipment, both supported and suspended, and all ductwork, or equipment required by latest edition of IBC.
- B. For Supported Equipment: The seismic restraints shall consist of interlocking steel members restrained by shock absorbent neoprene materials compounded to bridge bearing specifications. The elastomeric materials shall be replaceable and be a minimum 3/4" thick. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8", nor more than 1/4". Each snubber shall be capable of restraint in all three mutually orthogonal directions.
- C. Submittals shall include load versus deflection curves up to 1/2" in the x, y and z

- planes. Tests shall be conducted in an independent laboratory or under the signed supervision of an independent registered engineer. The snubber assemblies shall be bolted to the test machine as the snubber is normally installed. Test reports shall certify that neither the neoprene elements nor the snubber body has sustained any obvious deformation after release of the load.
- D. The contractor shall not install any equipment or pipe which makes rigid contact with the "building" unless it is approved in this specification or by the Engineer. "Building" includes slabs, beams, studs, walls, lath, etc.
 - E. The installation or use of vibration isolators must not cause any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, equipment and piping shall be maintained in a rigid position during installation. The load shall not be transferred to the isolator until the installation is complete and under full operational load.
 - F. The contractor shall correct, at no additional cost, all installations which are deemed defective in workmanship or materials by the Architect.

PART 3 - EXECUTION

3.1 EQUIPMENT ISOLATOR INSTALLATION:

- A. The equipment to be isolated shall be supported by a structural steel frame or by brackets attached directly to the machine where no frame is required.
- B. Brackets shall be provided to accommodate the isolator and provide a mechanical stop. The vertical position and size of the bracket shall be specified by the isolator manufacturer.
- C. The operating clearance between the bracket and the pad shall be $3/4"$ + or - $1/16"$. The minimum operating clearance between the frame and the pad shall be $1"$.
- D. The frame shall be placed in position and the brackets supported temporarily by $3/8"$ shims prior to the installation of the machine or isolators.
- E. After the entire system installation is completed and under full operational load, the isolator shall be adjusted so that the load is transferred from the shims to the isolator. When all isolators are properly adjusted, the shims will be barely free and shall be removed. Thereafter, the shims shall be used as a gauge to check that the $3/8"$ clearance is maintained so that the system will remain free of stress.
- F. Piping Isolator Installation - Vertical Riser or Horizontally Supported Piping:
 - 1. The isolators shall be installed with the isolator hanger box as close as possible to the structure.
 - 2. The isolators shall be suspended from overhead beams, never from slab diaphragms between beams unless specifically approved.
 - 3. Hanger rods shall be aligned to clear the hanger box.
 - 4. Load transfer isolators, when utilized, shall temporarily maintain the piping in a rigid position until installation is complete and fully loaded.

3.2 SEISMIC RESTRAINTS:

- A. General: All seismic restraints must be installed and adjusted so that the equipment and piping vibration isolation is not degraded by utilization of the restraints.
- B. Supported Equipment: Each vibration isolation frame for supported equipment shall have a minimum of four seismic snubbers mounted as close as possible to the vibration isolators and/or the frame extremities. Care must be taken so that a minimum 1/8" air gap in the seismic restraint snubber is preserved on all sides in order that the vibration isolation potential of the isolator is not compromised. This requires that the final snubber adjustment shall not be completed until the vibration isolators are properly installed and the installation approved.

END OF SECTION 15070

SECTION 15075 - PIPE AND EQUIPMENT IDENTIFICATION

PART 1 - GENERAL

1.1 SCOPE:

- A. Piping and Duct Identification
 - 1. All pipes shall be labeled and color coded with contents clearly identified and arrows indicating direction of flow. Identification shall meet campus standards.
- B. Equipment Identification
 - 1. Identify all equipment including gauges, meters, thermometers, mechanical equipment, ATC panels, junction boxes, and all other devices.
- C. Valve Tagging
 - 1. All valves shall be designated by distinguishing numbers and letters on required charts and diagrams. The Contractor shall furnish and install approved brass tags for all designated items, with numbers and letters on the tags corresponding to those on the charts and diagrams.
 - 2. Each valve shall have an identifying number identifying the unit. Standard identifications may be used for identifying type of service or fluid in pipe. The Contractor shall submit his system of identification to the Owner and Architect for approval prior to ordering. Any work done without this approval is done at the Contractor's own risk.
 - 3. Charts of all valves shall be furnished to Owner in duplicate by the Contractor. Charts shall indicate the following items:
 - a. Valve identification number
 - b. Location
 - c. Service or purpose
 - d. Normal Position

PART 2 - MATERIALS

2.1 PIPING AND DUCT IDENTIFICATION:

- A. Duct and piping background color shall be applied to all exposed piping (either over bare pipe or the insulation) in the mechanical rooms. Identifying lettering and arrows shall then be added as indicated above, and as necessary to be visible from anywhere in the room.
 - 1. For duct in mechanical rooms, chases, and other exposed areas, as well as piping routed in other exposed areas such as chases, background color shall be applied in a two foot (2'-0") wide band with identifying letterings and a flow direction arrow.
 - 2. Background and lettering shall be semi-gloss enamel paint by DeVoe (Mirrolac), Pratt and Lambert, Glidden, Rust-Oleum, Sherwin Williams or approved equal. The colors specified in table 1 shall not be varied
 - 3. Identifying lettering shall be painted or stenciled on duct or pipe over the background color. Self adhesive or glue-on type labels are acceptable. Letters shall be 2" high for duct and larger piping 3" or more, 1" high for 1-

- 1/4" to 2-1/2" pipe, and 1/2" high for 1" pipe and smaller.
4. Arrows to indicate direction of flow shall be painted over the background color in the same as the lettering. The arrow shall point away from the lettering. On duct and large piping 3" or more in diameter, the shaft of the arrow shall be 2" long and 1" wide. Smaller piping, 2-1/2" or less, shall have arrows with a shaft 1/2" wide and 2" long. Use a double-headed arrow if the flow can be either direction.
 5. Piping and duct shall be identified with the colors as listed on table 3

2.2 EQUIPMENT IDENTIFICATION:

- A. Equipment shall be identified with signs made of laminated plastic with 1/8" or larger engraved letters. Signs shall be securely attached by rust proof screwed or some other permanent means (no adhesives).
- B. Information on signs shall include name of equipment, identification on plans and schedules, rating maintenance instructions and any other important data not included on factory attached name plate.

2.3 VALVE TAGGING:

- A. Brass tags shall not be less than 1-1/2" diameter with depressed black-filled numbers not less than 1/2" high and black-filled letters not less than 1/4" high. Tags shall be securely fastened to valves with approved brass "S" hooks, or brass jack chain, in a manner to permit easy reading. Do not attach to valve wheel. Brass tags shall be as manufactured by Seton Name Plate Company, New Haven, Connecticut or approved equal.
- B. Permanent plastic cover for chart shall have two (2) holes to be punched at top of plastic closure to allow for affixing approximately an 8" length of nickel plated bead chain. Each hole to be reinforced by means of a small brass or nickel grommet. Plastic closure shall be as manufactured by Seton Name Plate Company, New Haven, Connecticut, or equal.

PART 3 - EXECUTION

3.1 PIPING IDENTIFICATION:

- A. Markers shall be installed in strict accordance with manufacturer's instructions. Use vinyl tape first and stick markers over tape. This procedure assures that the tape will not fall off.
- B. On chalky and loose insulation, soft, porous, fiber-filled or fiberglass covering, a spiral wrap of pipe banding tape shall be made around the circumference of the pipe. Sufficient spiral wraps shall be made to accommodate the horizontal dimension of the pipe marker.
- C. On bare pipes, painted pipes, and pipes insulated with a firm covering pipe banding tape matching the background color of the marker shall be used. After applying pipe markers, wrap pipe banding tape around pipe at each end of marker. Tape should cover 1/4" to 1/2" to 1" on itself. Be sure pipe surface is dry

- and free of dirt or grease before applying markers or banding tape.
- D. Stenciling may be used in lieu of the above labels and markers if finished application gives the same overall appearance, that is that stenciling is applied over a background color. If stenciling, is used, letter heights, background colors, banding and arrows shall be as specified above. Submit sample to Owner before proceeding with work.
- E. Apply markers so they can be read from floor.

3.2 EQUIPMENT IDENTIFICATION:

- A. Signs shall be attached to equipment so they can be easily read. Attachment shall be by screws or rivets. Glue shall not be used.
- B. A sample identification sign for equipment shall be as follows: CU - 1 Computer Room Unit CFM
- C. NOTE: Avoid using only the architects designations as used on plans; identify equipment as to area or zone served.

3.3 REMOVABLE AND NON-REMOVABLE CEILING TILE:

- A. Where valves, VAV boxes, fire dampers, adjustment controls, etc. are located above ceiling tile, an identification on the lay in tile tee bar shall be provided to indicate the tile to be removed for access to a particular item. In general, 1/2 inch high black stick on or stencil letters are to be used indicating the device such as VAV for VAV box, CWV for cold water valve, FD for fire damper, E for other electrical devices, etc. The code used shall be provided in the operations and maintenance manual.
- B. For non-accessible ceiling and ceilings without tee bars, provide hinged access doors at each valve, fire damper, damper operator and VAV box.

3.4 VALVE TAGGING:

- A. Provide one valve chart mounted in a frame with clear glass front, and secured on a wall in the equipment rooms, or in a location as otherwise directed by the Architect.
- B. Provide a second valve chart for use outside of the equipment room. Chart shall be provided with an approved heavy transparent plastic closure for permanent protection.
- C. Where existing charts are available new valve charts are not required. Just add valves to existing charts
- D. Identify all valves. A sample identification as follows:

VALVE #1
COLD WATER
OPEN

- E. Sample Identification Chart is as follows:
The room numbers used on the actual chart shall be the room numbers actually used. Do not use architectural room numbers shown on plans.

TABLE 1 APPROVED PAINT AND COLORS

| COLOR | SHERWIN WILLIAMS | PRATT AND LAMBERT | RUST-OLEUM |
|--------------|-------------------------|--------------------------|--------------------------|
| Green | SW4085 Safety Green | Safety Green | 933 Federal Safety Green |
| Black | Black | Effecto Black | 634 Black |
| White | White | Effecto White | 1766 White |
| Silver | B59S11 Silver Brite | - | - |

TABLE 2 SAMPLE VALVE IDENTIFICATION CHART

| NUMBER | DESCRIPTION | LOCATION | NORMAL POSITION |
|---------------|----------------------------------|-----------------|------------------------|
| 1. | Cold water supply to hose bibb. | Room # | Open |
| 2. | Hot water supply to toilet room. | Chase # | Open |

TABLE 3 PIPE AND DUCTWORK COLOR CODE SCHEDULE

| MEDIUM IN PIPE OR DUCT | BACKGROUND COLOR | IDENTIFYING LETTERING | LETTERING COLOR |
|-------------------------------|-------------------------|------------------------------|------------------------|
| Automatic Controls | Silver | Control Air | Black |
| Refrigerant: Freon | Black | Freon | White |
| Cold Water (potable) | Green | Domestic Cold Water | White |
| Domestic (potable) Hot Water | Green | Domestic Hot Water | White |
| Domestic Hot Water return | Green | Domestic Hot Water Return | White |
| Waste: Building Waste | (Unpainted or black) | Waste | White |

END OF SECTION 15075

SECTION 15081 - DUCT INSULATION

PART 1 - GENERAL

1.1 SCOPE:

- A. Includes -
 - 1. Insulating of concealed round above grade supply air ducts that are not lined. All ductwork routed outside of building insulation envelope.
 - 2. Insulation shall have surface burning characteristics as determined by ASTM E84 with a flame spread rating of 25 and a smoke developed of 50.
- B. Related Work specified Elsewhere -
 - 1. Acoustical insulation inside air ducts is specified in Section 15822.
 - 2. Insulated flex duct specified in Section 15818.

PART 2 - PRODUCTS

2.1 INSULATION:

- A. 1-1/2 inch thick fiberglass with aluminum foil scrim kraft facing and have a density of one lb/cu ft.
- B. Approved Manufacturers:
 - 1. Johns-Manville Microlite FSK
 - 2. CSG Type IV standard duct insulation
 - 3. Owens-Corning FRK-25
 - 4. Knauf (Duct Wrap FSK)

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install duct wrap in accordance with Manufacturer's recommendations.
- B. Do not compress insulation except in areas of structural interference.
- C. Joints shall be completely sealed.

END OF SECTION 15081

SECTION 15083 - CULINARY WATER PIPE INSULATION

PART 1 - GENERAL

1.1 SCOPE:

- A. Includes -
 - 1. Insulating of all above ground culinary hot water, recirculating hot water, and cold water lines and fittings, and underside of wall hung lavatories for handicapped.
 - 2. The insulation products used on the project shall be of one manufacturer, unless specifically excepted. All pipe insulation shall meet the requirements of IBC.
 - 3. Insulation products on this project shall be installed by a licensed insulation contractor using materials, and methods described in this section. Installation by other than an experienced licensed contractor shall not be acceptable.

PART 2 - PRODUCTS

2.1 INSULATION:

- A. Snap-on glass fiber pipe insulation with surface burning characteristics as determined by ASTM E84 with a flame spread rating not to exceed 25 and smoke developed not to exceed 50.
- B. Snap-on glass fiber pipe insulation. Heavy density pipe insulation with a factory applied vapor barrier jacket.
- C. Approved Manufacturers:
 - 1. Owens-Corning
 - 2. Johns-Manville
 - 3. CSG
 - 4. Knauf
- D. Thickness shall be as noted in Table 1.

2.2 COVERING:

- A. Where piping is susceptible to damage, and/or routed below 6'0" above finished floor, provide with heavy duty PVC jacket.
 - 1. Jacket material shall be a minimum of .030 inches thick and white in color unless directed otherwise by Architect.
 - 2. Approved Manufacturers
 - a. Ceel-Tite 320 by Ceel Co.
 - b. Prior approved equal

PART 3 - EXECUTION

3.1 PIPING:

- A. General
 - 1. Pipe insulation shall be continuous through the sleeve.
 - 2. A PVC jacket shall be provided over the insulation wherever caulking is required.
 - 3. Insulation shall be continuous through hangers.
 - 4. Support points such as hangers or rollers shall have a calcium silicate support block or inserts provided by insulation manufacturer to protect insulation from crushing. See section 15101.
- B. Cold Lines
 - 1. Insulation shall be applied to clean, dry pipe with joints tightly butted and the ends of the insulation sealed off with vapor barrier coating at intervals not to exceed 15 feet.
 - 2. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.
 - 3. All laps and butt strips shall be secured with adhesive and stapled on 4-inch centers.
 - 4. Staples and seams, including those on self-sealing lap systems shall be coated with a vapor barrier coating.
 - 5. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating as specified for butt strips. The patch shall extend not less than 1-1/2 inches past the break.
 - 6. At penetrations such as thermometers, the void in the insulation shall be filled with vapor barrier coating and the penetration shall be sealed with a brush coat of the same coating.
- C. Hot Lines
 - 1. Insulation shall be applied to clean, dry pipe with joints tightly butted.
 - 2. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches, and butt strips 3 inches wide shall be provided for circumferential joints.
 - 3. Laps and butt strips shall be secured with adhesive and stapled on 4-inch centers. Adhesive may be omitted where pipe is concealed.
 - 4. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as noted for butt strips. Patch shall extend not less than 1-1/2 inches past the break.
 - 5. The run of the line pipe insulation shall have the ends brought up to the item.

3.2 FITTINGS:

- A. Insulate fittings with same type and thickness of insulation as pipe, with ends of insulation tucked snugly into throat of fitting and edges adjacent to pipe insulation tufted and tucked in or tapered.
- B. Cover insulation with one piece "Zeston" type PVC fitting cover or equal by Ceel Co. secured by stapling or taping ends to adjacent pipe covering.

- C. Alternate Method -
1. Insulate fittings with one inch of insulating cement and vapor seal with two 1/8 inch wet coats of vapor barrier mastic reinforced with glass fabric extending two inches onto adjacent insulation.

TABLE 1
Pipe Insulation Thickness

| PIPE SYSTEM | PIPE SIZE | | |
|-------------|------------|--------------|--------------|
| | 1" OR LESS | 1-1/4" TO 2" | 2-1/2" TO 4" |
| HOT WATER | 1" | 1" | - |
| COLD WATER | 1/2" | 3/4" | - |

END OF SECTION 15083

SECTION 15084 - REFRIGERANT PIPE INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. Furnish and install insulation on above ground refrigerant piping and fittings as described in Contract Documents.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Flexible Foamed Pipe Insulation
 - 1. Thickness -
 - a. 1/2 inch for one inch outside diameter and smaller pipe.
 - b. 3/4 inch for 1-1/8 through 2 inch outside diameter pipe.
 - c. One inch for 2-1/8 inches outside diameter and larger pipe (two layers of 1/2 inch).
 - d. One inch sheet for fittings as recommended by Manufacturer.
 - 2. Approved Manufacturers -
 - a. AP Armaflex by Armstrong
 - b. Halstead Insul-Tube
 - c. Rubatex
- B. Joint Sealer
 - 1. Approved Manufacturers -
 - a. Armaflex 520
 - b. BFG Construction Adhesive No. 105
 - c. Rubatex R-373
- C. Insulation Tape
 - 1. Approved Manufacturers -
 - a. Armaflex AP Tape
 - b. Rubatex R-180-FS Tape
- D. Exterior Finish
 - 1. Approved Manufacturers -
 - a. WB Armaflex Finish by Armstrong
 - b. Rubatex Protective Coating 67x944
- E. Sleeves - Galvanized 26 ga steel, 9 inches long

PART 3 EXECUTION

3.1 INSTALLATION

- A. For condensing units, install insulation on above ground refrigerant suction piping and fittings, including thermal bulb from thermal expansion valve.
- B. Install insulation in snug contact with pipe and in accordance with Manufacturer's recommendations.

1. Insulate flexible pipe connectors.
 2. Insulate thermal expansion valves with insulating tape.
 3. Insulate fittings with sheet insulation and as recommended by Manufacturer.
- C. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to a minimum.
- D. Install insulation on lines through clamp assembly of pipe support. Do not butt insulation up against sides of clamp assembly. Install sleeve around insulation at each clamping location to prevent crushing of insulation when clamp is tightened.
- E. Stagger joints on layered insulation. Seal joints in insulation.
- F. Install insulation exposed outside building so 'slit' joint seams are placed on bottom of pipe.
- G. Paint exterior exposed insulation with two coats of specified exterior finish.

END OF SECTION 15084

SECTION 15101 - PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 RELATED SECTIONS:

- A. Division 15010 General applies to this Section.

1.2 SCOPE:

- A. Includes -
 - 1. General piping installation, materials and procedures for all piping systems.
- B. Related Work Specified Elsewhere -
 - 1. Type of pipe and fittings for culinary water, drainage, etc. shall be specified in that particular Section.

PART 2 - PRODUCTS

2.1 HANGERS:

- A. Provide one of the following types of hangers for horizontal piping. Comparable products of Grinnell, Globe Pipehanger, B-Line, Michigan Hanger, Superstrut or Piping Technology and Products (PTP) considered equal.
- B. Except as otherwise specified hereinafter: Clevis type, B-Line Fig. B3100.
- C. Where pipe exceeds maximum loading recommended for Clevis type Hangers, provide steel pipe clamp, B-Line Fig. B3140 or Fig. B3142, depending on loading.
- D. Provide trapeze hangers where several pipes can be installed parallel and at the same level. Trapeze hangers shall consist of 2 steel channels bolted back to back spaced for rod hangers at each end. Use roller chairs B-Line B3120 pipe roll stands B-Line B3117 SL where provision for expansion is required.
- E. Supporting rods shall be attached to concrete by inserts placed before concrete is poured for pipes up to 8 inches.
- F. Supporting rods over 18 inches long shall be braced at every fourth hanger with diagonal bracing attached to slab or beam.
- G. Spring hangers shall be used for support of pipe within 100 diameters distance of coils, or pumps, as needed to isolate vibration. Springs shall be sized 1" static deflection. Vibrex type HXAP-PC adjustable spring hangers.
- H. For copper tubing use copper hanger; or dielectrically isolate.

2.2 FLOOR SUPPORTS:

- A. Provide one of the following means of supporting horizontal piping from floor:
- B. Pipe Saddle Support, B-Line, Fig. B3095 with pipe nipples to suit. Fasten to floor.
- C. Where provision for expansion are required, pipe-roll stands, B-Line Fig. B3120 without vertical adjustment, B-Line Fig. B3122 with vertical adjustment as required. Provide concrete piers, fasten stands to piers.

2.3 WALL SUPPORTS:

- A. Provide one of the following means of supporting horizontal piping from wall:
- B. B-Line B-200 pipe clamp.
- C. For hanger suspension, 750 pound maximum loading, light welded steel bracket with hole for one rod, 3/4 inch diameter. B-Line Fig. B3068.
- D. For pipe roll stand support, welded-steel bracket, light for 700 pound maximum loading, B-Line Fig. B3063, medium for 1500 pound maximum loading Fig. B, heavy for 3000 pound maximum loading Fig. B3067.

2.4 VERTICAL PIPING SUPPORTS:

- A. Vertical pipe supports shall be steel extension pipe clamps, B-Line Fig. B3373 or Fig. B3131, refer to manufacturer's rated maximum loading for each size pipe. Bolt clamp securely to pipe, rest clamp-end extension on building structure.
- B. Where pipe sleeves extend above floor, place pipe clamps at ceiling below, support clamp-end extension from inserts.

2.5 CLAMPS:

- A. Beam clamps shall be malleable iron, B-Line Fig. B442 for 1/4 inch hanger rods; forged steel beam clamp, B-Line B321 for hanger rod up to 1-1/2 inches.

2.6 PIPE COVERING PROTECTION:

- A. Provide calcium silicate blocks in the bottom 1/2 diameter of pipe to protect insulation at areas of contact with hangers and supports. Material shall be 8 inches long for pipes up to 3 inches and 12 inches long for pipes 3-1/2 inches and larger. Insulation manufacturer supplied inserts shall be acceptable.

2.7 WALL AND CEILING PLATES:

- A. Fit pipes passing through walls, floors, and ceiling with wall plates of proper size to cover openings around pipes. Plates will not be required at floor slabs where sleeves project above floor and space between pipe and sleeve is caulked and sealed. Plates shall be equal to Beaton and Cadwell No. 10, pressed steel plates. Floor plates shall be chromium plated. Wall and ceiling plates shall be prime coated.

2.8 UNIONS AND COUPLINGS:

- A. Unions: Malleable iron, brass to iron seat, ground joint, same materials as pipe. Crane, Walworth, or approved equal.
- B. Dielectric Unions: Mechanical Contractor shall install dielectric union or couplings whenever copper pipe connects to steel pipe or other items of equipment. Couplings and unions shall be as manufactured by the Water Vallot Company of Detroit, Michigan, or approved equal.

2.9 PIPING SPECIALTIES:

- A. Provide thermometers, pressure gages, vents, and other miscellaneous piping specialties as shown or as may be required by usual good practices for a complete system. .

2.10 VALVES:

- A. Provide on each valve a name plate showing manufacturer, valve size, grade, and pressure temperature service rating.
- B. See specific piping system sections for valves to be used in that system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Furnish and install a complete system of piping, valved as indicated or as necessary to completely control entire apparatus. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper erection of systems of piping in every respect.
- B. Properly support piping and make adequate provision for expansion, contraction, slope, and anchorage.
 - 1. Cut piping accurately for fabrication to measurements established at site and work into place without springing or forcing.
 - 2. Do not use pipe hooks, chains, or perforated metal for pipe support.
 - 3. Remove burr and cutting slag from pipes.
- C. Piping shall not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings. Provide accessible, ground joint unions in piping at connections to equipment.
- D. Make connections of dissimilar metals with insulating couplings.
- E. Provide sleeves around pipes passing through floors, walls, partitions, or structural members.
 - 1. Seal sleeves with plastic or other acceptable material.
 - 2. All piping passing through floors and outside walls and foundations shall have a water tight sleeve and water tight caulking around pipe. Extend pipe sleeve minimum of 3 inch above floor.
- F. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of systems. Do not use plugs of rags, wool, cotton waste, or similar materials.
- G. Install piping systems so they may be easily drained.
- H. Do not place water piping within building perimeter in contact with earth.
- I. Valves of same type shall be of same Manufacturer.
- J. Do not use reducing bushings, street elbows, or close nipples.
- K. Make changes in direction with proper fittings. Bending of pipe is not approved.
- L. Hanger rods shall be of a diameter adequate to support pipe size.
- M. Install additional supports as required.

- N. Suspend all piping in building except that underground. Laying of piping on any building member is not allowed.
- O. Design all hangers to support the required loads. Where necessary, supports shall be designed to permit movement due to expansion and contraction. Where drawings show details of supports and anchors, conform to details shown. Where details are not shown, conform to General Requirements specified in sub-paragraph.
- P. Horizontal Piping Support Schedule: Support horizontal piping of steel, cast iron, plastic, and copper as follows:

HORIZONTAL PIPING SUPPORT SCHEDULE

| Pipe Size | Rod Diameter | Maximum Spacing |
|---------------|--------------|-----------------|
| Up to 1-1/4" | 3/8" | 8'-0" |
| 1-1/2" and 2" | 3/8" | 10'-0" |
| 2-1/2" and 3" | 1/2" | 10'-0" |
| 4" and up | 5/8" | 12'-0" |

- Q. Piping with nonpressure type joints such as Soil and Waste Piping shall be supported with a minimum of two hangers per pipe section.
- R. Support horizontal lines of copper tubing with hangers. Space not more than 8 feet center to center.
- S. Cutting or other weakening of the building structure to facilitate installation will not be permitted. The Contractor shall demonstrate that no weight or stress is placed upon the equipment by the piping and that piping and connection of equipment are in perfect alignment. When so directed, disconnection and reconnection of piping shall be done by Contractor for designated pipe section to properly demonstrate stress; this shall be at no cost to Owner.
- T. Flanges or unions as applicable for the type of piping specified shall be provided in the piping at connections to all items of equipment. All piping shall be installed to insure noiseless circulation. All valves and specialties shall be placed, packed and adjusted at the completion of the work before final acceptance.
- U. Operating Valves shall be accessible for operation from floors or platforms where feasible, and handwheels shall not be more than 4'-6" above the floor or platform. In other cases, valves and cocks shall be equipped with chain operated handwheels or extension stems, or other suitable means of remote control.
 - 1. Tighten glands and add additional gland packing as required before final inspection.
- V. Provide sufficient clearance for insulated piping and fittings to permit application of insulation without cutting either pipe line covering or fitting coverings.

3.2 PIPE PROTECTION:

- A. Do not run piping in outside wall, or where freezing may occur. Piping in attic spaces shall be run on the interior side of building insulation.
- B. No water piping in building shall be in contact with earth.
- C. All piping as installed shall be plugged or capped until equipment has been permanently connected.

3.2 GRADE AND DRAINAGE:

- A. All piping shall be erected to insure proper draining. Grade soil, waste, and drainage lines not less than 1/4" per foot unless noted otherwise on drawings.

3.3 CROSS CONNECTIONS:

- A. No plumbing fixture, device or piping shall be installed which will provide a cross-connection or interconnection between a distributing water supply for drinking or domestic purposes and polluted source.
- B. Provide all hose bibbs and other vent or drain valves equipped with a hose connection with a vacuum breaker.

3.4 FLEXIBLE CONNECTIONS:

- A. Shall be provided wherever pipe connects to motor operated equipment.

3.5 DIELECTRIC FITTINGS:

- A. Shall be used to connect dissimilar metals (such as steel and copper) to prevent electrolytic action.

3.6 PIPE JOINTING:

- A. Soldered Piping:
 - 1. Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool before sweating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections. Joints for sweated fittings shall be made with a non-corrosive paste flux and solid wire solder. Use 95-5 or 96-4 Tin-Antimony solder. Cored solder will not be permitted.

3.7 FLASHINGS:

- A. Wherever roof is pierced by work installed by this Contractor, he shall furnish proper flashings to be installed by the Roofing Contractor. All piercings of roof shall be sealed air and water tight.
- B. Provide proper flashings, counter flashings, metal collars or other work as required to make weather tight seal at all fan connections, duct piercings, etc., as shown and/or required for work installed under this Contract.
- C. All pipes passing through the roof shall be neatly flashed with Stonemen Stormite four pound seamless lead flashing assembly, with reinforced conical

boot, complete with vandal-proof hooded cast iron counter flashing and Permaseal waterproofing compound. Hood shall have a minimum of 2 to 1 free area to vent pipe size. Flashing flanges shall be an 18 inch square base. Coordinate work with Roofing Contractor to avoid duplication of flashings and work.

- D. 16 oz sheet copper flashings may be used in lieu of lead. Flashing shall be fitted snugly around pipe. Caulk between flashing and pipe to seal. Make water and air tight using a flexible waterproof compound. Base shall be 24" square.

3.8 PIPE CLEANING AND DISINFECTION:

- A. All piping shall be flushed clean before connection to equipment. Domestic water lines shall be thoroughly flushed out with an alkaline detergent solution to remove pipe dope, oil, loose mill scale, and other extraneous materials.
- B. After the water system has been flushed clean, the shutoff valve to the water main shall be closed. All fixture outlets shall be opened slightly. A solution of sodium hypochlorite and clean water shall be introduced at the new tie-in to the existing water pipes downstream of new valve, until residual chlorine is detected at all water faucets, outlets, etc. The solution shall consist of 1 gallon of 5 percent sodium hypochlorite (Chlorox or Purex) to 200 gallons of water. The solution shall be flushed and all aerators and strainers shall be removed, cleaned and replaced. Care shall be taken to not allow solution to enter existing piping.
- C. Contractor shall furnish to Owner and Architect a written report certifying completion that pipe cleaning and disinfection has been completed and accepted.

3.9 PIPE TESTING:

- A. Test all piping prior to painting, insulating, or other concealment. Valve off or isolate controls, fittings, equipment or other piping which may be damaged by testing pressures. Provide relief valves set to avoid bursting pressure during test.
- B. Soil, waste, rainwater and vent systems shall be filled to roof level with water and show no leaks over a 24 hour period.
- C. Domestic water piping shall be hydrostatically tested at 100 psi with less than a four percent drop in pressure over a six hour period.

END OF SECTION 15101

SECTION 15140 - HOT AND COLD WATER SYSTEMS

PART 1 - GENERAL

1.1 SCOPE:

- A. Includes -
 - 1. Furnish and install all culinary hot, recirculating hot and cold water piping shown on the drawings complete with necessary valves, connections, and accessories inside the building and connect into cold water service piping where shown on the drawings.
 - 2. All water systems shall meet the requirements of ANSI/NSF Standard 61 Section 9 (1998), concerning metal contaminants in the water system.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS:

- A. Inside Building
 - 1. Hot and cold water service piping: Type L, copper, hard drawn with wrought copper fittings.

2.2 VALVES:

- A. Interior culinary water valves shall be ball type.
 - 1. Con Bra Co "Apollo"
 - 2. Hammond
 - 3. Honeywell - Braukmann
 - 4. Jenkins
 - 5. Milwaukee
 - 6. Nibco - Scott
 - 7. Stockham
 - 8. Watts

2.3 VACUUM BREAKERS AND BACKFLOW PREVENTERS:

- A. Backflow preventers and vacuum breakers shall be installed in water lines to provide protection against cross contamination. Such devices shall be of approved manufacture and installed in accordance with the Uniform Plumbing Code. Provide backflow preventers for:
 - 1. Hose bibbs
 - 2. Any fixture that accommodates a hose or tubing connection (i.e. faucets, etc.)
 - 3. Make-up water lines to mechanical equipment
 - 4. Any item required by code to have same
- B. Backflow preventers, vacuum breakers and completed assembly shall comply with the International Plumbing Code.

2.4 HYDRAULIC SHOCK (WATER HAMMER) CONTROLS:

- A. Provide hydraulic shock controls for flush valves and water header. Shock controls shall be Smith, Zurn, Wade, or Josam.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. For general piping installation, see Section 15101.
- B. Piping Inside of Building
 - 1. Provide valves on hot and cold water lines to rest rooms and class rooms, for zone control of system. Provide access for all valves.
 - 2. Do not run piping in outside walls or ceiling space unless it is located on the building side of insulation envelope.
 - 3. Locate cold water piping a minimum of six inches from hot water piping.
 - 4. Before pipes are covered, buried, etc. Contractor shall test the piping installation in the presence of the Architect, and Owners Representative. Piping shall be tested as described in Section 15101.
- C. Pipe Sterilization and Disinfection
 - 1. Sterilize the new domestic water system as described in Section 15101, paragraph I.
 - 2. After sterilization, flush solution from system with clean water until residual chlorine content is less than 0.2 parts per million.
 - 3. Water system will not be accepted until a negative bacteriological test is made on water taken from system. Chlorine dosing shall be repeated as necessary until such negative test is accomplished. Submit written report of test to Architect and Owner for their approval.
 - 4. When connecting into existing water lines, Contractor shall properly protect and cap the existing piping or Contractor shall stand the cost of cleaning and disinfecting the existing piping system to Owner's satisfaction.

END OF SECTION 15140

SECTION 15150 - SOIL, WASTE, AND VENT PIPING SYSTEM

PART 1 - GENERAL

1.1 SCOPE:

- A. Includes -
 - 1. Furnish and install all soil, waste, and vent piping systems within the building and connect with existing piping as indicated on the drawings.

1.2 REFERENCES:

- A. American Society For Testing And Materials
 - 1. ASTM A 74-96, 'Standard Specification for Cast Iron Soil Pipe and Fittings'
 - 2. ASTM C 564-95a, 'Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings'

PART 2 - PRODUCTS

2.1 Cast Iron Piping and Fittings

- A. Above Grade Piping And Vent Lines
 - 1. Approved Types -
 - a. Service weight, no-hub type cast iron soil pipe meeting requirements of ASTM A 74.
 - 1) Joint Material -
 - a) No-Hub Pipe - Neoprene gaskets with stainless steel cinch bands.
- B. Fittings
 - 1. Cast Iron Pipe - Fittings for no-hub pipe shall meet requirements of ASTM A 74.
 - a. Joint Material - Rubber gaskets meeting requirements of ASTM C 564.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. For general piping installation requirements, see Section 15101.
- B. ALL PIPING:
 - 1. Regulatory Requirements
 - a. Install clean outs in accordance with local governing authority and State codes.
 - 2. Performance Requirements
 - a. Failure to install joints properly shall be cause for rejection and replacement of piping system..
- C. Metal Pipe And Fittings

1. Do not caulk threaded work.
 2. Use torque wrench to obtain proper tension in cinch bands when using hubless cast iron pipe. Butt ends of pipe against centering flange of coupling.
- D. PLACE CLEAN OUTS:
1. Where shown on Drawings and at base of each stack and riser.
 2. At every 90 degree change of direction for horizontal line.
 3. Every 50 feet of straight horizontal run.
 4. Extend clean out to accessible surface. Do not place clean outs in carpeted floors. In such locations, use wall type clean outs.
 5. Clean outs in piping outside building shall be extended to grade with adequate covers for planted or concrete areas.
- E. Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have a P-trap in connection with a complete venting system so gasses pass freely to atmosphere with no pressure or syphon condition on water seal. Clean outs and plugs shall not be provided on P-traps.
- F. Before piping is concealed, Contractor shall test the piping installation in the presence of Architect, and Owners Representative, and correct leaks or defective work. Do not caulk threaded work.
1. Metal Pipe System -Fill new portions of waste and vent system to roof level with water, 10 feet minimum, and show no leaks for two hours. Correct leaks and defective work.
- G. Vent new portions of waste system to atmosphere. Discharge vent piping 14 inches above roof. Join lines together in fewest practical number before projecting through roof. Locate vent lines so they will not pierce roof near an edge or valley. Where possible reuse existing vent lines.
- H. Use torque wrench to obtain proper tension in cinch bands (above ground) when using hubless cast iron pipe. Butt ends of pipe against centering flange of coupling.
- I. Flash pipes passing through roof in accordance with the requirements of Section 15101.

END OF SECTION 15150

SECTION 15181 - CONDENSATE DRAIN PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. Furnish and install condensate drain piping as described in Contract Documents.
- B. Related Sections
 - 1. Section 15051 - General Mechanical Requirements

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Condensate Drains
 - 1. Type M copper for condensate drains from computer room unit.
 - 2. 3 inch deep seal, vented water trap adjacent to cooling coil connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Condensate Drains
 - 1. Support piping and protect from damage.

END OF SECTION 15181

SECTION 15184 - REFRIGERANT PIPING & SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. Furnish and install piping and specialties for refrigeration systems as described in Contract Documents.
- B. Related Sections
 - 1. Section 15084 - Refrigerant Piping Insulation

1.2 REFERENCES

- A. American National Standards Institute / American Welding Society
 - 1. ANSI / AWS A5.8-92, 'Standard Specification for Brazing Alloys'
- B. American Society For Testing And Materials
 - 1. ASTM A 36-97a, 'Standard Specification for Carbon Structural Steel'
 - 2. ASTM A 361-94, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process for Roofing and Siding'
 - 3. ASTM B 280-98, 'Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service'

1.3 SUBMITTALS

- A. Shop Drawings - Show each individual equipment and piping support
- B. Quality Assurance / Control - Technician certificate for use of CFC and HCFC refrigerants

1.4 QUALITY ASSURANCE

- A. Qualifications - Refrigerant piping shall be installed by a refrigeration contractor licensed by State and by technicians certified in use of CFC and HCFC refrigerants.

PART 2 PRODUCTS

2.1 COMPONENTS

- A. Refrigerant Piping
 - 1. Meet requirements of ASTM B 280, hard drawn straight lengths. Soft copper tubing not permitted.
 - 2. Do not use pre-charged refrigerant lines.
- B. Refrigerant Fittings
 - 1. Wrought copper with long radius elbows.
 - 2. Approved Manufacturers -
 - a. Mueller Streamline

- b. Nibco Inc
 - c. Grinnell
 - d. Elkhart
- C. Suction Line Traps
 - 1. Manufactured standard one-piece traps.
 - 2. Approved Manufacturers -
 - a. Mueller Streamline
 - b. Nibco Inc
 - c. Grinnell
 - d. Elkhart
- D. Connection Material
 - 1. Brazing Rods in accordance with ANSI / AWS A5.8 -
 - a. Copper to Copper Connections -
 - 1) Classification BCuP-4 Copper Phosphorus (6 percent silver).
 - 2) Classification BCuP-5 Copper Phosphorus (15 percent silver).
 - b. Copper to Brass or Copper to Steel Connections - Classification BAg-5 Silver (45 percent silver).
 - c. Do not use rods containing Cadmium.
 - 2. Flux -
 - a. Approved Manufacturers -
 - 1) Stay-Silv White Brazing Flux by J W Harris Co
 - 2) High quality silver solder flux by Handy & Harmon
- E. Valves
 - 1. Expansion Valves -
 - a. For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.
 - b. Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.
 - c. Approved Manufacturers -
 - 1) Alco
 - 2) Henry
 - 3) Mueller
 - 4) Parker
 - 5) Sporlan
 - 2. Manual Refrigerant Shut-Off Valves -
 - a. Ball valves designed for refrigeration service and full line size.
 - b. Valve shall have cap seals.
 - c. Valves with hand wheels are not acceptable.
 - d. Provide service valve on each liquid and suction line at compressor.
 - e. If service valves come as integral part of condensing unit, additional service valves shall not be required.
 - f. Approved Manufacturers -
 - 1) Henry
 - 2) Mueller

- 3) Superior
 - 4) Virginia
- E. Filter-Drier
 - 1. On lines 3/4 inch outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.
 - 2. On lines smaller than 3/4 inch outside diameter, filter-drier shall be sealed type using flared copper fittings.
 - 3. Size shall be full line size.
 - 4. Approved Manufacturers -
 - a. Alco
 - b. Mueller
 - c. Parker
 - d. Sporlan
 - e. Virginia
- F. Sight Glass
 - 1. Combination moisture and liquid indicator with protection cap.
 - 2. Sight glass shall be full line size.
 - 3. Sight glass connections and sight glass body shall be solid copper or brass, no copper-coated steel sight glasses allowed.
 - 4. Approved Manufacturer -
 - a. Alco AMI
- G. Flexible Connectors
 - 1. Designed for refrigerant service with bronze seamless corrugated hose and bronze braiding.
 - 2. Approved Manufacturers -
 - a. Anaconda 'Vibration Eliminators' by Anamet
 - b. Vibration Absorber Model VAF by Packless Industries
 - c. Vibration Absorbers by Superior Valve Co
 - d. Style 'BF' Spring-flex freon connectors by Vibration Mountings

2.2 MATERIALS

- A. Refrigerant Piping Supports
 - 1. Base, Angles, And Uprights - Steel meeting requirements of ASTM A 36.
 - 2. Securing Channels -
 - a. At Free-Standing Pipe Support -
 - 1) Acceptable Manufacturers And Models -
 - a) P-1000 Unistrut channels
 - b) Hilti HS-158-12 channels
 - b. At Wall Support -
 - 1) Acceptable Manufacturers And Models -
 - a) P-3300 Unistrut channels
 - b) Hilti HS-1316-12 channels
 - c. At Suspended Support -
 - 1) Acceptable Manufacturers And Models -
 - a) P-1001 Unistrut channels
 - b) Hilti MS-41 channels
 - 3. Angle Fittings -

- a. Acceptable Manufacturers And Models -
 - 1) P-2626 90 degree Unistrut angle
 - 2) Hilti MW2 angle
- 4. Pipe Clamps -
 - a. Acceptable Manufacturers -
 - 1) Hydra-Zorb
 - 2) ZSI Cush-A-Clamp
 - 3) Hilti Cush-A-Clamp
- 5. Protective Cover - 18 ga steel, hot-dipped galvanized to meet requirements of ASTM A 361, 1.25 oz/sq ft.

2.3 MANUFACTURERS

- A. Alco Controls Div, Maryland Heights, MO (314) 569-4500
www.alcocontrols.com
- B. Anamet Industrial Inc, Waterbury, CT (800) 243-3567 www.anametinc.com
- C. Cush-A-Clamp by ZSI Manufacturing, Westland, MI (800) 323-7053
www.cushaclamp.com
- D. Elkhart Products Corp, Elkhart, IN (219) 264-3181 www.elkhartproducts.com
- E. Grinnell Corp, Exeter, NH (888) 610-6101 www.grinnell.com
- F. Handy & Harmon Products Division, Fairfield, CT (800) 245-2728
www.handyharmon.com
- G. J W Harris Co Inc, Cincinnati, OH (800) 733-4533 www.jwharris.com
- H. Henry Valve Co, Melrose Park, IL (800) 964-3679
www.paulsenpartners.com/henry-valve/
- I. Hilti Inc, Tulsa, OK (800) 879-8000 www.hilti.com
- J. Hydra-Zorb Co, Auburn Hills, MI (248) 373-5151 www.hydra-zorb.com
- K. Mueller Steam Specialty, St Pauls, NC (877) 831-9464
www.muellersteam.com
- L. Nibco Inc, Elkhart, IN (800) 642-5463 www.nibco.com
- M. Packless Industries, Waco, TX (800) 347-4859 www.packless.com
- N. Parker Hannefin Corp, Cleveland, OH (216) 896-3000 www.parker.com/cig/
- O. Sporlan Valve Co, Washington, MO (314) 239-1111
- P. Superior Refrigeration Products, Washington, PA (724) 225-8000
www.superiorvalve.com
- Q. Unistrut Corp, Wayne, MI (800) 521-7730 www.unistrut.com
- R. Vibration Mountings & Controls, Bloomingdale, NJ (800) 569-8423
www.vmc-kdc.com
- S. Virginia KMP Corp, Dallas, TX (800) 285-8567

PART 3 EXECUTION

3.1 INSTALLATION

- A. Refrigerant Lines
 - 1. Install as high in mechanical areas as possible. Do not install

- underground or in tunnels.
 - 2. Slope suction lines down toward compressor one inch/10 feet. Locate traps at vertical rises against flow in suction lines.
- B. Connections
 - 1. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary. No soft solder (tin, lead, antimony) connections will be allowed in system.
 - 2. Braze manual refrigerant shut-off valve, sight glass, and flexible connections.
 - 3. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.
- C. Specialties
 - 1. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlet at same end of coil.
 - 2. Install thermostatic bulb as close to cooling coil as possible. Do not install on vertical lines.
 - 3. Install equalizing line in straight section of suction line, downstream of and reasonably close to thermostatic bulb. Do not install on vertical lines.
 - 4. Provide flexible connectors in each liquid line and suction line at both condensing unit and evaporator on systems larger than five tons and at condensing unit for units 5 tons and under. Anchor pipe near each flexible connector.
- D. Refrigerant Supports
 - 1. Support Spacing -
 - a. Piping 1-1/4 inch And Larger - 8 feet on center maximum.
 - b. Piping 1-1/8 inch And Smaller - 6 feet on center maximum.
 - c. Support each elbow.
 - 2. Isolate pipe from supports and clamps with Hydrozorb or Cush-A-Clamp systems.
 - 3. Run protective cover continuous from condensing units to risers or penetrations at building wall.

3.2 FIELD QUALITY CONTROL

- A. Make evacuation and leak tests in presence of Architect's Engineer and owners representative after completing refrigeration piping systems. Positive pressure test will not suffice for procedure outlined below.
 - 1. Draw vacuum on each entire system with two stage vacuum pump. Draw vacuum to 300 microns using micron vacuum gauge capable of reading from atmosphere to 10 microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum.
 - 2. Break vacuum with nitrogen and re-establish vacuum test. Vacuum shall hold for 30 minutes at 300 microns without vacuum pump running.
 - 3. Conduct tests at 70 deg F ambient temperature minimum.
 - 4. Do not run systems until above tests have been made and systems started up as specified. Inform Owner's Representative of status of

- systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.
5. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.
 6. Recover all refrigerant in accordance with applicable codes. Do not allow any refrigerant to escape to atmosphere.
- B. If it is observed that refrigerant lines are being or have been brazed without proper circulation of nitrogen through lines, all refrigerant lines installed up to that point in time shall be removed and replaced at no additional cost to Owner.

END OF SECTION 15184

SECTION 15410 - PLUMBING FIXTURES AND TRIM

PART 1 - GENERAL

1.1 SCOPE

- A. Division 15010, 15051, and 15101 applies to this Section.
- B. All sinks and lavatories shall have a shut-off valve on all water supply lines on the room side of the fixture. All valves must have a gasket seat, not a ground joint. Supply lines from the valve shall be 3/8" brass, chrome plated.
- C. Interior exposed pipe, valves, and fixture trim shall be chrome plated.
- D. Complete installation of each fixture including P-trap and accessories with accessible stop or control valve in each hot and cold water branch supply line.
- E. Polish chrome finish at completion of Project.
- F. Water closets and urinals shall have screwdriver stop valves on flush valves. Flush valves shall be of the exposed type.
- G. Fixtures to be all of one type.
- H. Floors shall slope to drains.
- I. Caulk between fixtures and wall and floor with white butyl rubber non-absorbent caulking compound. Point all edges.
- J. Install fixtures and fittings as per local codes and Manufacturer's instructions. Fixtures shall be mounted level.
- K. Do not use flexible water piping.
- L. Provide fixture carriers for each fixture. Each carrier shall be of the proper type and size for fixture installed and installation location (wall or chase). Approved manufacturers are Wade, Smith, Josam, and Zurn.
- M. All plumbing fixtures, trim and accessories in contact with the culinary water system shall comply with the requirements of ANSI/NSF 61 Section 9, (1998). Every box containing such component shall carry a notice of compliance including Testing Lavatory providing classification/certification and control number.

PART 2 - PRODUCTS

2.1 FIXTURES

- A. Water Closets: Wall Mounted Flush Valve Handi-cap
 - 1. Fixture
 - a. American Standard - AFTWALL Water Saver 2257.103 Siphon Jet elongated bowel, 1-1/2" top spud.
 - b. Kohler - Kingston K-4330-ET Siphon Jet elongated bowel 1-1/2" top spud.
 - c. Eljer - Auburn water saver siphon jet 111-1405 with 1-1/2" top spud.
 - 2. Flush Valve ADA Approved
 - a. Lever handle operation
 - b. Screwdriver Stop
 - c. Approved Manufacturers

1. Sloan Royal or equal by
 2. Delany
 3. Zurn
- B. Seat - (Provide split front type with check hinge)
1. Approved Manufacturers
 - a. American Standard "Church"
 - b. Crane Embassy
 - c. Bemis
 - d. Kohler
 - e. Olsonite
 - f. Beneke
 - g. Spertzel
- C. Lavatories: ADA Approved
1. Self Supporting Fixture
 - a. Size 20" x 18" with 4" centers/arm carrier or wall mount bracket as required.
 - 1) American Standard Lucerne - 0356.051 vitreous china
 - 2) Kohler - Greenwich K-2032
 - 3) Eljer Delwyn 051-1644
 2. Fittings -
 - a. Faucet And Drain -
 - 1) Approved Manufacturers And Models -
 - a) American Standard - 5402.172H
 - b) Cambridge Brass - 21T344
 - c) Chicago - 1802A-E3-317
 - d) Delta - 2523 HDF
 - e) Eljer - 559-2200 with 803-0530 drain.
 - f) Kohler - K-7404-5-A with K-13885 drain.
 - g) Sanitary Dash - R7308
 - h) Speakman - SC-3075-ADA
 - i) T & S Brass - B-890
 - b. Supply pipes with stops -
 - 1) Provide stuffing box and chrome plating.
 - 2) Approved Manufacturers And Models -
 - a) Brass Craft - TCR 1912 A-CP
 - b) Eastman - C 5M12-SBT-CP
 - c. Traps -
 - 1) 17 ga tube 'P' trap, chrome plated
 - 2) Approved Manufacturers -
 - a) Dearborn
 - b) McGuire
 - c) Sanitary Dash
 - d. Safety Shields -
 - 1) Where McGuire traps are furnished, they shall be provided with factory installed insulation and covers.
 - 2) For supply stops and all other p-traps the following kits are approved:
 - a) Trapwrap by Brocar Products

- b) Prowrap by McGuire Products
 - c) Handi Lav-Guard by True Bro
- D. Floor Drains
 - 1. with chrome plated strainer and deep seal p-trap.
 - a. Wade 1100 with 2450-t trap or equal by Josam, Smith or Zurn
 - 2. with chrome plated strainer, deep seal p-trap and chrome plated 4" funnel
 - a. Wade 1100 with 2450-t trap or equal by Josam, Smith or Zurn
- E. Hose Bibb-
 - 1. With vacuum breaker and loose key handle
 - 2. Woodford Model 24P Polish Chrome finish or equal by
 - 3. Chicago (Polish Chrome Finish)
 - 4. Hammond (Brass Finish)
- F. Break Room Sink
 - 1. Fixtures -
 - a. Self rimming, 18 ga stainless steel, satin finish.
 - b. Approved Manufacturers And Models -
 - 1) One Compartment -
 - a) Elkay - LR 1918
 - b) Just - SL-17519-A-GR
 - 2. Fittings -
 - a. Provide flow control fittings on spouts in place of aerator.
 - b. Supply -
 - 1) One or compartment sink -
 - a) Approved Manufacturers And Models
 - 1] American Standard - 7270.342H
 - 2] Cambridge Brass - 27T2443CB with 11 inch spout
 - 3] Chicago - 1888
 - 4] Crane - C-5011B
 - 5] Delta - 2100 HDF modified with 4381 handles
 - 6] Eljer - 718-1000
 - 7] Kohler - K-7761-T
 - 8] Speakman - SC-5763
 - 9] T & S Brass - B-855 with 180F and B-199-1
 - c. Waste -
 - 1) Approved Manufacturers And Models
 - a) Crane - 8-5241
 - b) Eljer - 803-0580
 - c) Elkay - LK-99
 - d) Just - JB-99
 - e) Kohler - K-8801
 - f) Sanitary Dash - SS250W
 - d. Supply pipes with stops -
 - 1) Provide stuffing box and chrome plating.
 - 2) Approved Manufacturers And Models

- a) Brass Craft - TCR 1912 A-CP
 - b) Eastman - C5M12-SBT-CP
 - e. Trap -
 - 1) 17 ga tube 'P' trap, chrome plated
 - 2) Approved Manufacturers -
 - a) Dearborn
 - b) McGuire
 - c) Sanitary Dash
- G. Cleanouts:
 - 1. Approved Types -
 - a. Finish Floors - Wade W6000, Zurn A-1420-2, Smith 4023-T
 - b. Resilient Flooring - Wade W6000-T, Zurn Z-1400-6, Smith 4140
 - c. Finished Wall - Wade W8460-R-5, Zurn Z-1445-1, Smith 4530
 - d. Exposed Drain Lines - Wade W8560A, Zurn Z-1440-A, Smith 4515
 - e. General Purpose - Wade W8550A, Zurn Z-1440-a, Smith 4405

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install complete system in accordance with plumbing code.

END OF SECTION 15410

SECTION 15416 - DRINKING WATER COOLING SYSTEMS

PART 1- GENERAL

A SUMMARY

1. Includes But Not Limited To
 - a. Furnish and install drinking water cooling system units as described in Contract Documents.
2. Related Sections
 - a. Section 15010 & 15051 - General Mechanical Requirements
 - b. Section 15140 - Potable Water Piping System

PART 2- PRODUCTS

A GENERAL

1. Interior exposed pipe, valves, and fixture trim shall be chrome plated.
2. Do not use flexible water piping.

B. MANUFACTURED UNITS

1. Handicap Accessible Bi-Level Fountain
 - a. Include accessory fountain. Vandal proof operating bar on front and both sides. 7.8 GPH minimum of 50 deg F water with 90 deg F room temperature, 1/5 horsepower motor, 120 V, 60 Hz, single phase. Flexi-guard or chrome plated brass bubbler.
 - b. Approved Manufacturers And Models -
 - 1) Elkay - Model EBFATL-8
 - 2) Halsey Taylor - HAC8BL-Q
 - 3) Haws - HWBFA8L
 - 4) Oasis - Model PLF8WMQSL
 - 5) Sunroc - NWCA-8-BL

B. MANUFACTURERS

1. Elkay Manufacturing Co, Oak Brook, IL (630) 574-8484 www.elkay.com
2. Halsey Taylor, Oak Brook, IL (630) 574-3500 www.halseytaylor.com
3. Haws Corp, Sparks, NV (888) 640-4297 or (510) 528-2812 www.hawscorp.com
4. Oasis Corp, Columbus, OH (800) 950-3226 or (614) 861-1350 www.oasiswatercoolers.com
5. Sunroc Corp, Dover, DE (800) 478-6762 or (302) 678-7800 www.sunroc.com

PART 3- EXECUTION

A. INSTALLATION

1. Install fixtures with accessible stop or control valve.
2. Mounting
 - a. Coordinate location of fountain with location and height of electrical outlet to ensure concealment of outlet by fountain.
 - b. Handicap Accessible Bi-Level Fountain -
 - 1) Anchor bottom of fountain to wall.
 - 2) Top surfaces to be 40 and 32 inches above floor unless required otherwise by local code.
 - 3) Install 3/8 inch IPS union connection and Chicago No. 376 stop to building supply line.
 - 4) Install 1-1/4 inch IPS slip cast brass 'P' trap. Install trap so it is concealed.

A. CLEANING

1. Polish chrome finish at completion of Project.

END OF SECTION 15416

SECTION 15735 - COMPUTER ROOM UNIT

PART 1 - GENERAL

1.1 SCOPE

- A. Provide and install ceiling mounted self contained computer room air conditioning equipment with remote air cooled condenser including interconnecting refrigerant piping.

1.2 RELATED SECTIONS

- A. Section 15087 - Refrigerant Piping Insulation
- B. Section 15184 - Refrigerant Piping and Specialties

PART 2- PRODUCTS

2.1 SUMMARY

- A. These specifications describe requirements for a precision environmental control system.
- B. The system shall be designed to maintain temperature and humidity conditions in the rooms containing electronic equipment.
- C. The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation requirements of the room.

2.2 DESIGN REQUIREMENTS

- A. The precision environmental control system shall be self-contained factory assembled ceiling mounted unit. The system shall have capacities as scheduled on the drawings.

2.2 SUBMITTALS

- A. Submittals shall be provided and shall include:
 - 1. Single-line diagrams; dimensional, electrical, and capacity data.
 - 2. Piping and electrical connection drawings.
 - 3. Capacities
 - 4. Electrical requirements.

2.3 QUALITY ASSURANCE

- A. The specified system shall be factory-tested before shipment.
- B. Testing shall include, but shall not be limited to:
 - 1. Quality Control Checks
 - 2. "High-Pot" Test (two times rated voltage plus 1000 volts, per UL requirements.)
 - 3. Metering Calibration Tests

- C. The system shall be designed and manufactured according to world class quality standards.
- D. The manufacturer shall be ISO 9001 certified.

2.4 CABINET AND FRAME CONSTRUCTION

- A. The cabinet and chassis shall be constructed of heavy gauge galvanized steel and designed for easy installation and service access from one side and bottom of unit only.
- B. Mounting holes shall be factory attached to the cabinet.

2.5 AIR DISTRIBUTION

- A. The air distribution system shall be constructed with a direct-drive fan assembly equipped with double-inlet blower, self-aligning ball bearings, and a lifetime lubrication.
- B. Fan motor shall be permanent-split capacitor, high efficiency type, equipped with two speeds for air flow modulation.
- C. Dehumidification shall utilize lower fan speed.

2.6 SUPPLY AND RETURN GRILLE

- A. A factory supplied supply and return grille kit shall be provided for supply and return delivery through a 2' X 4' ceiling grid.

2.7 FILTERS

- A. The filters shall be rated not less than 20% efficiency based on ASHRAE Dust Weight Arrestance Test.
- B. Shall be removable without shutting down the system.

2.8 MICROPROCESSOR CONTROL

- A. The control system shall be microprocessor based.
 - 1. The wall mounted control enclosure shall include a 2-line by 16 character LDC display providing continuous display of operating status and alarm condition.
 - 2. An 8-key membrane keypad shall be located below the display. Key pad shall:
 - a. Setpoint/program control
 - b. Unit on/off
 - c. Fan speed
- B. The LCD display shall provide:
 - 1. On/off indication
 - 2. Fan speed indication
 - 3. Operating mode indication (cooling and heating)
 - 4. Current day.
 - 5. Current Time

6. Current Temperature indication
- C. Control parameters
 1. Temperature Setpoint 65-85EF (18 to 29EC)
 2. Temperature Sensitivity 1E to 5EF (1E to 5EC)
- B. Unit controls
 1. Compressor Short-Cycle Control
 - a. The control system shall prevent compressor short-cycling by a 3 minute timer from compressor stop to the next start.
 2. Common Alarm and Remote On/Off
 - a. A common alarm relay shall be provided to interface alarms with a remote alarm device. Two (2) terminals are also provided for remote on/off control. Individual alarms shall be "enabled" or "disabled" from reporting to the common alarm.
 3. Setback Control
 - a. The control shall be programable on a daily basis or on a 5 day/2 day program schedule. It shall be capable of accepting 2 programs per day..
 4. Temperature Calibration
 - a. The control shall include the capabilities to calibrate the temperature sensors and adjust the sensor response delay time from 1 to 90 seconds. The control shall be capable of displaying temperature values in Fahrenheit and Celsius.
 5. System Auto Restart
 - a. For start up after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming shall be preformed at the unit.

2.9 ALARMS

- A. Unit Alarm
 1. The control system shall monitor unit operation and activate an audible and visual alarm in the event of the following factory present alarm conditions.
 - a. High Temperature
 - b. Low Temperature
 - c. High Head Pressure
 - d. Loss of Power
 - e. Compressor Short Cycle
- B. Custom Alarms
 1. Water Detected
 2. Smoke Detected
 3. User-customized text can be entered for the two (2) custom alarms.
- C. Alarm Controls
 1. Each alarm (unit and custom) shall separately enabled or disabled, seleted to activate the common alarm, and programmed for a time delay of 0 to 255 seconds.
- D. Audible Alarm
 1. Audile alarm shall annunciate any alarm that is enabled by the operator.

- E. Common Alarm
 - 1. A programmable common alarm shall be provided to interface user selected alarms with a remote alarm device.

2.10 DISCONNECT SWITCH, NON-LOCKING TYPE

- A. The non-automatic molded case circuit interrupter shall be mounted in the high voltage section of the electrical panel.
- B. The switch shall be accessible with the door closed.

2.11 REMOTE SENSORS

- A. The unit shall be supplied with remote temperature and humidity sensors.
- B. The sensors shall be connected to the unit by a shielded cable.

2.12 DIRECT EXPANSION SPLIT SYSTEMS

- A. Direct Expansion Coil
 - 1. Shall be constructed of copper tubes aluminum fins.
 - 2. The coil shall be provided with a stainless steel drain pan.
- B. Refrigeration System
 - 1. The refrigeration system shall consist of an evaporator, externally equalized expansion valve, and filter drier.
- C. Propeller fan Condensing Unit
 - 1. The condenser coil shall be constructed of copper tubes and aluminum fins with a direct-drive propeller type fan.
 - 2. All components shall be factory assembled, charged with refrigerant and sealed.
 - 3. Condenser shall be designed for 95EF (35EC) ambient and be capable of operation to -30EF (-34.4EC)

2.13 APPROVED MANUFACTURERS

- A. Leibert
- B. Stulz Air Technology Systems Inc.
- C. Prior Approved Equal

PART 3 - EXECUTION

A - GENERAL

- A. Install air conditioning unit in accordance with manufacturer's installation instructions.
- B. Install unit plumb and level, firmly anchored in location indicated, and maintain manufacturer's recommended clearances.

3.1 ELECTRICAL WIRING

- A. Install and connect electrical devices furnished by manufacturer but not specified to the factory mounted.
- B. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.

3.2 PIPING CONNECTIONS

- A. Install and connect devices furnished by manufacturer but not specified to the factory mounted.
- B. Furnish copy of manufacturer's piping connection diagram submittal to refrigeration contractor.

3.3 WATER PIPING

- A. Connect drains to air conditioning unit.
- B. Provide pitch and trap as manufacturer's instructions and local codes require.

3.4 FIELD QUALITY CONTROL

- A. Start up air conditioning unit in accordance with manufacturer's startup instructions.
- B. Test controls and demonstrate compliance with requirements.

END OF SECTION

SECTION 15801 GENERAL DUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. General procedures and requirements for ductwork.
 - 2. Repair leaks in ductwork, as identified by smoke test, at no additional cost to Owner.
- B. Related Sections
 - 1. Division 09 - Quality of acoustic sealant
 - 2. Division 13 - Air test and balance and smoke testing of ductwork
 - 3. Section 15051 - General Mechanical Requirements

1.2 SUBMITTALS

- A. Samples - Sealer and gauze proposed for sealing ductwork.
- B. Quality Assurance / Control
 - 1. Manufacturer's installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.
 - 2. Specification data on sealer and gauze proposed for sealing ductwork.

1.3 QUALITY ASSURANCE

- A. Requirements - Construction details not specifically called out in this Section shall conform to applicable requirements of SMACNA HVAC Duct Construction Standards.
- B. Pre-Installation Conference - Schedule meeting immediately before installation of ductwork.

PART 2 PRODUCTS

- A. Finishes Where Applicable - Colors as selected by Architect.
- B. Duct Hangers
 - 1. One inch by 18 ga galvanized steel straps or steel rods as shown on Drawings, and spaced not more than 96 inches apart. Do not use wire hangers.
 - 2. Attaching screws at trusses shall be 2 inch No. 10 round head wood screws. Nails not allowed.

PART 3 EXECUTION

3.1 INSTALLATION

- A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.
- B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.
- C. Hangers And Supports
 - 1. Install pair of hangers close to each transverse joint and elsewhere as required by spacing indicated in table on Drawings.
 - 2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
 - 3. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.

3.2 CLEANING

- A. Clean interior of duct system before final completion.

END OF SECTION 15801

SECTION 15812 - ROUND STEEL DUCTWORK

PART 1 - GENERAL

1.1 RELATED SECTIONS -

- A. Division 01 General and Sections 15010 and 15051 are part of this Section.

PART 2 - PRODUCTS

2.1 MATERIAL -

- A. Ducts -
 - 1. Fabricate of zinc-coated lockforming quality steel sheets meeting requirements of ASTM A 527-80, "Sheet Steel Zinc Coated (Galvanized) by the Hot-Dip Process, Lock Forming Quality", with Type G coating.
 - 2. Use of aluminum or non-metal ducts is forbidden.
 - 3. Duct shall be constructed to SMACNA Pressure Class ½" to 2" standards.
- B. Joints
 - 1. Mechanical type joints shall be sealed with:
 - a. Design Polymetrics 1010
 - b. Mon-Eco Industries 44-52 or equal by
 - c. Hardcast, Durodyne, or HB Fuller
 - 2. Welded joints are acceptable.
 - 3. Joints shall be as recommended in SMACNA HVAC Duct Construction Standards for round duct.
- C. Fittings:
 - 1. Ducts shall be provided with 45 and 90 degree elbows of 2 piece die stamped construction.

- 2.2 Ductwork shall be shop fabricated or spiral ductwork manufactured by a manufacturer regularly engaged in the manufacture of this type of ductwork. Ductwork shall meet all requirements of SMACNA and manufacturer be prior approved.

- 2.3 Standing seam duct may be used in lieu of spiral duct if properly constructed for velocity and pressures encountered.

- 2.4 Duct take-offs and volume dampers. See Section 15821.

PART 3 - EXECUTION

3.1 PERFORMANCE -

- A. Ducts
 - 1. Straight and smooth on inside with joints neatly finished unless otherwise directed.

END OF SECTION 15812

SECTION 15813 - MEDIUM VELOCITY DUCTWORK

PART 1 - GENERAL

1.1 RELATED SECTION:

- A. Division 01 General and Section 15010 and 15051 are part of this section.

PART 2 - PRODUCTS

- 2.1 Supply air ductwork shown upstream of Dual Duct boxes shall be spiral acoustical duct consisting of an externally pressure-tight metal sheet, a layer of fire resistant fiber glass insulation, an internal liner next to the air flow and a perforated galvanized steel liner. All fittings shall have solid, perforated steel liners. All other round above grade supply and return air ductwork as described in Section 15812 shall be wrapped with insulation. Ductwork shall meet SMACNA pressure class 2" and 3" requirements minimum.
- 2.2 Equal to United Sheet Metal Acoustic K-27.
- 2.3 Manufacturers shall be those regularly engaged in the manufacturers of this product. Approved manufacturers, United Sheet Metal, Dee's, Metco, or prior approved equal.
- 2.4 As an alternative standing seam ductwork may be used in lieu of spiral duct as long as it is constructed for velocity and pressures encountered.
- 2.5 Joint Sealer
 - A. Mon-Eco 44-52
 - B. Design Polymetrics 1010 or equal buy
 - C. Hard cast, Duro Dyne, H.B. Fuller

PART 3 - EXECUTION

- 3.1 Duct installation and sealing shall be in strict accordance with SMACNA HVAC duct construction standards and HVAC air duct leakage test manual.

END OF SECTION 15813

SECTION 15816 - RECTANGULAR STEEL DUCTWORK

PART 1 - GENERAL

1.1 SCOPE -

- A. Includes -
 - 1. Furnish and install the ½" to 2" wg ductwork and related items specified below and shown on the Drawings.
 - 2. Ductwork shall be installed in strict accordance with SMACNA Standards (latest edition) for exterior installation.
- B. Related Work Specified Elsewhere -
 - 1. General Division 01 and Section 15010 and 15051 are a part of this Section.

PART 2 - PRODUCTS

2.1 DUCT MATERIAL -

- A. Fabricate of zinc-coated lockforming quality steel sheets meeting requirements of ASTM A 527-80 with Type G coating.
- B. Use of aluminum or non-metal ducts is forbidden.

PART 3 - EXECUTION

3.1 DUCTS -

- A. Straight and smooth on inside with joints neatly finished unless otherwise directed.
- B. Duct panels through 48 inch dimension having acoustic duct liner need not be cross broken or beaded.
- C. Brace and install ducts so they shall be free of vibration under all conditions of operation.
- D. Make duct take-offs to branches, registers, grilles, and diffusers as detailed on drawings.
- E. Ducts shall be large enough to accommodate inside acoustic duct liner.
- F. Install internal ends of slip joints in direction of flow. Make joints air tight using mastic type duct sealer.
- G. Cover horizontal and longitudinal joints on all ducts with Mon - Eco 44-52 or Design Polymetrics 101 Sealer or equivalent by Duro Dyne Corporation, Hardcast, or H.B. Fuller Company.

3.2 Install flexible inlet and outlet duct connections to terminal units, fan coils, air handlers and exhaust fans.

3.3 Provide each duct take-off with an adjustable volume damper to balance that branch -

- A. Anchor dampers securely to duct.

- B. Install dampers in main ducts within insulation.
- C. Dampers in branch ducts shall fit against sheet metal walls, bottom and top of duct, and be securely fastened. Cut duct liner to allow damper to fit against sheet metal.

3.4 Install grilles and diffusers.

3.5 AIR TURNS -

- A. Permanently installed, consisting of curved metal blades or vanes arranged to permit air to make abrupt turn without appreciable turbulence, in elbows of supply and above ground return ductwork.
- B. Air turns shall be quiet and free from vibration when system is in operation.

END OF SECTION 15816

SECTION 15818 - FLEXIBLE DUCT

PART 1 - GENERAL

1.1 DESCRIPTION -

- A. Includes But Not Limited To -
 - 1. Supply air branch duct runouts to diffusers where indicated on Drawings.
- B. Related Work Specified Elsewhere -
 - 1. Volume dampers and sheet metal duct specified in Section 15 812.

1.2 RELATED SECTIONS -

- A. Division 01 General and Sections 15010 and 15051 are part of this Section.

PART 2 - PRODUCTS

2.1 MATERIAL -

- A. Ducts -
 - 1. Formable, flexible, circular duct which shall retain its cross-section shape, rigidity, and shall not restrict air flow after bending.
 - 2. Nominal 1-1/2 inches thick, 3/4 lb/cu ft density fiberglass insulation with air-tight, see-through polyester core, sheathed in seamless vapor barrier jacket factory-installed over flexible assembly.
 - 3. Each individual component in assembly, including insulation, ductwork and vapor barrier, shall meet Class I requirement of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.
 - 4. Approved Manufacturers -
 - a. Flexmaster
 - b. Thermaflex
 - c. Wiremold

PART 3 - EXECUTION

3.1 INSTALLATION -

- A. Install duct in fully extended condition free of sags and kinks, using 3'-0" maximum lengths.

END OF SECTION 15818

SECTION 15819 - DUCTWORK TESTING

PART 1 - GENERAL

1.1 RELATED SECTIONS -

- A. Division 01 General and Sections 15010 and 15051 are part of this Section.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 PROCEDURE

- A. All ductwork shall be tested prior to concealing or other work which may prevent repair of ductwork. Refer to "Inspection Notice", Section 15051.
- B. Duct testing shall consist of pressurizing the duct system either with the main blower or in sections using a portable blower. Each portion of ductwork to be tested shall be sealed at all openings. The ductwork shall be subjected to an internal pressure not less than 2" W.G or 1-1/2 times working pressure whichever is larger. All ductwork shall be surveyed for audible leaks, and structural stability. Leaks shall be sealed, weak joints repaired, vibrations eliminated. A log shall be kept by the contractor indicating date, conditions, repairs made, and name of individual(s) performing the test. A copy of the log shall be retained for possible observation at the request of the Owner or architect. Ductwork shall maintain test pressure with not more than 10% variation over the period of the test.

END OF SECTION 15819

SECTION 15820 - DUCT ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. Furnish and install duct accessories in specified ductwork as described in Contract Documents.
- B. Related Sections
 - 1. Section 15051 - General Mechanical Requirements
 - 2. Section 15920 - Temperature control dampers actuators and actuator linkages

1.2 REFERENCES

- A. American Society for Testing and Materials
 - 1. ASTM A 653-96, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process'
 - 2. ASTM C 665-96, 'Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing'
 - 3. ASTM C 1071-91, 'Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)'

PART 2 PRODUCTS

2.1 COMPONENTS

- A. Flexible Equipment Connections
 - 1. 30 oz closely woven UL approved glass fabric, double coated with neoprene.
 - 2. Fire retardant, waterproof, air-tight, resistant to acids and grease, and withstand constant temperatures of 200 deg F.
 - 3. Approved Manufacturers -
 - a. Cain - N-100
 - b. Duro Dyne - MFN
 - c. Elgen - ZLN
 - d. Ventfabrics - Ventglas
- B. Duct Access Doors
 - 1. Factory built insulated access door with hinges and sash locks. Construction shall be galvanized sheet metal, 24 ga minimum.
 - 2. Fire and smoke damper access doors shall have a minimum clear opening 12 inches square or as shown on Drawings to easily service fire damper.
 - 3. Approved Manufacturers -
 - a. AirBalance - Fire/Seal FSA 100

- b. Cesco-Advanced Air - HAD-10
 - c. Elgen - Model 85 A
 - d. Flexmaster - Spin Door
 - e. Kees Inc - ADH-D
 - f. Pottorff - 60-HAD
 - g. Ruskin - ADH-24
 - h. Safe-Air - SAH
- C. Dampers & Damper Accessories
 - 1. Concealed Ceiling Damper Regulators -
 - a. Approved Manufacturers -
 - 1) Cain
 - 2) Duro Dyne
 - 3) Metco Inc
 - 4) Vent-Lock - 666
 - 5) Young - 301
 - 2. Volume Dampers -
 - a. Factory-manufactured 16 gauge galvanized steel, single blade and opposed blade type with 3/8 inch axles and end bearings. Blade width 8 inches maximum. Blades shall have 1/8 inch clearance all around.
 - 1) Damper shall operate within acoustical duct liner.
 - 2) Provide channel spacer equal to thickness of duct liner.
 - b. Dampers above removable ceiling and in Mechanical Rooms shall have locking quadrant on bottom or side of duct. Otherwise, furnish with concealed ceiling damper regulator and cover plate.
 - c. Approved Manufacturers -
 - 1) American Warming
 - 2) Arrow
 - 3) Cesco
 - 4) Daniel
 - 5) Greenheck
 - 6) Pottorff
 - 7) Ruskin
 - 8) UTEMP
 - 9) Safe-Air
- D. Air Turns
 - 1. Single thickness vanes with one inch trailing edge. Double thickness vanes not acceptable.
 - 2. 4-1/2 inch wide vane rail. Junior vane rail not acceptable.
- E. Branch Tap for Round and Flexible Ductwork (High efficiency type)
 - 1. Factory-manufactured rectangular-to-round or round-to-round 45 degree leading tap fabricated of 24 ga zinc-coated lockforming quality steel sheets meeting requirements of ASTM A 653, with G-90 coating.
 - 2. One inch wide mounting flange with die formed corner clips, pre-punched mounting holes, and adhesive coated gasket.
 - 3. Manual Volume Damper -
 - a. Single blade, 22 ga minimum
 - b. 3/8 inch minimum square rod with brass damper bearings at

- each end.
 - c. Heavy duty locking quadrant on 1-1/2 inch high stand-off mounting bracket attached to side of round duct.
 - 4. Approved Models & Manufacturers -
 - a. HETD-L by Daniel Manufacturing, Ogden, UT (801) 622-5924
 - b. STO by Flexmaster USA Inc, Houston, TX (713) 462-7694
 - c. HET by Sheet Metal Connectors Inc, Minneapolis, MN (612) 572-1100
 - d. Prior approved equal

2.1 FABRICATION

- A. Air Turns
 - 1. Permanently install vanes arranged to permit air to make abrupt turn without appreciable turbulence, in 90 degree elbows of above ground supply and return ductwork.
 - 2. Quiet and free from vibration when system is in operation.
 - 3. Junior vain rails are not acceptable

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install flexible inlet and outlet duct connections to each dual duct
- B. Access Doors In Ducts
 - 1. Install at each manual outside air damper and at each motorized damper. Locate doors within 6 inches of installed dampers.
 - 2. Install within 6 inches of fire dampers and in Mechanical Room if possible.
- C. Dampers & Damper Accessories
 - 1. Install concealed ceiling damper regulators.
 - a. Paint cover plates to match ceiling tile.
 - b. Do not install damper regulators for dampers located directly above removable ceilings or in Mechanical Rooms.
 - 2. Provide each take-off with an adjustable volume damper to balance that branch.
 - a. Anchor dampers securely to duct.
 - b. Install dampers in main ducts within insulation.
 - c. Dampers in branch ducts shall fit against sheet metal walls, bottom and top of duct, and be securely fastened. Cut duct liner to allow damper to fit against sheet metal.
 - d. Where concealed ceiling damper regulators are installed, provide cover plate.

END OF SECTION 15820

SECTION 15821 - FIRE AND SMOKE DAMPERS

PART 1 GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. Furnish and install fire and smoke dampers described in Contract Documents.
- B. Related Sections
 - 1. Section 15010 - General Mechanical Requirements

1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies
 - 1. Dampers shall conform to NFPA and SMACNA requirements and bear UL label.
 - 2. Dampers shall be approved by fire authorities having jurisdiction where so required.
 - 3. Combination fire / smoke dampers shall conform to UL 555 'Fire Damper Test Standard' and to UL 555S 'Leakage Rated Damper Test Standard'

1.3 MAINTENANCE

- A. Extra Materials - Leave six fusible links of each rating type used on Project with Owner.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- A. Standard Combination Fire / Smoke Dampers
 - 1. 1-1/2 hour rated and Class II 250 deg F leakage rated minimum.
 - 2. Power-open, fail-close non-stall type motorized damper operating at 115v and drawing 0.2 amps maximum.
 - 3. Damper actuator / assembly shall be controlled closure type. Instantaneous closure type is not acceptable.
 - 4. Damper shall close -
 - a. On signal from smoke detectors
 - b. On power Failure
 - c. When temperatures at damper exceed 165 deg F
 - 5. Frame shall be 16 ga minimum steel with 22 ga minimum steel blades.
 - 6. Blade seals shall be mechanically locked into blade edge. Clip-on and adhesive type seals are not acceptable.
 - 7. Jamb seals shall be flexible metal compression type.
 - 8. Serviceable from access doors located on either side of damper.
 - 9. Approved Manufacturers & Models -

- a. Air Balance - Model FS2250A
- b. CESCO - Model FSD
- c. Ruskin - Model FSD36
- d. Safe Air Inc - Model 771
- e. Pottorff - Model 5030
- f. Prefco - 5020

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fire and smoke dampers as follows
 - 1. Install standard combination fire / smoke dampers in ducts where ducts penetrate fire rated smoke barriers.
- B. Install smoke dampers within 24 inches of smoke barrier.

END OF SECTION 15821

SECTION 15822 - DUCT LINER

PART 1 - GENERAL

1.1 SCOPE -

- A. Includes -
 - 1. Acoustical lining of all new rectangular supply and return air ductwork -
- B. Insulation materials, adhesives, coatings, and other accessories shall have surface burning characteristics as determined by ASTM E 84 not to exceed 25 for flame spread and 50 for smoke developed. Flame proofing treatments subject to deterioration due to the effect of moisture or high humidity are not acceptable.

1.2 Duct dimensions shown on drawings are for inside of duct liner and does not include liner insulation.

1.3 RELATED SECTIONS -

- A. Division 01 General and Sections 15010 and 15051 are part of this Section.

PART 2 - PRODUCTS

2.1 DUCT LINER -

- A. One inch thick, 1-1/2 lb density fiberglass.
- B. Approved Manufacturers -
 - 1. CSG Ultralite OR Tough guard
 - 2. Johns-Manville Lina-Coustic
 - 3. OCF Aeroflex
 - 4. Knauf Type M

2.2 ADHESIVE -

- A. Design Polymetrics DP 2501 or 2502
- B. Mon-Eco Industries 22-67
- C. Duro Dyne WBG
- D. Hardcast IA-901

2.3 MECHANICAL FASTENERS -

- A. Conform to Mechanical Fastener Standard MF-19/1.
- B. Pins that attach to ductwork with adhesives are not allowed.
- C. Approved Manufacturers -
 - 1. Duro Dyne
 - 2. Omark dished head "Insul-Pins"
 - 3. Grip nails may be used if each nail is installed by "Grip Nail Air Hammer" or by "Automatic Fastener Equipment" in accordance with Manufacturer's

recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install mat finish surface on air stream side. Secure insulation to cleaned sheet metal duct with a continuous 100% coat of adhesive and with mechanical fasteners spaced as shown on drawings. Pin all duct liner.
- B. Accurately cut liner and thoroughly coat exposed edges of duct liner, including diffuser drop cut-outs with adhesive to seal fibers. Butt joints tightly. Top and bottom sections of insulation shall overlap sides.
- C. Keep duct liner clean and free from dust. At completion of project, vacuum duct liner if it is dirty or dusty.
- D. If insulation is installed without horizontal, longitudinal, and end joints butted together and properly treated, installation will be rejected and work removed and replaced with work that conforms to this specification. See drawings for detail of joint treatment.

END OF SECTION 15822

SECTION 15836 - EXHAUST FANS

PART 1 GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. Furnish and install exhaust fans as described in Contract Documents.
- B. Related Sections
 - 1. Section 15010 - General Mechanical Requirements

1.2 QUALITY ASSURANCES

- A. Requirements of Regulatory Agencies - Bear AMCA seal and UL label.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- A. Ceiling Mounted Exhaust Fans -
 - 1. Acoustically insulated housings. Sound level rating of 4.6 sones maximum for fan RPM and CFM listed on Drawings.
 - 2. Include chatterproof integral back-draft damper with no metal to metal contact.
 - 3. True centrifugal wheels.
 - 4. Entire fan, motor, and wheel assembly shall be easily removable without disturbing housing.
 - 5. Suitably ground motors and mount on rubber-in shear vibration isolators.
 - 6. Provide wall or roof cap, as required.
 - 7. Approved Manufacturers -
 - a. Breidert
 - b. Carnes
 - c. Cook-Gemini
 - d. Greenheck Sp
 - e. Pace
 - f. Penn Zephyr

PART 3 EXECUTION

3.1 INSTALLATION

- A. Anchor fan units securely to structure.

END OF SECTION 15836

SECTION 15840 - TERMINAL AIR UNIT

PART 1 - GENERAL

A SCOPE -

1. Furnish and install dual duct constant air volume terminal boxes as shown and scheduled on drawings.

B. QUALITY ASSURANCE

1. Terminals shall be certified under the ARI Standard 880-94 Certification Program and carry the ARI seal.

PART 2 - PRODUCTS

A. TERMINAL UNITS

1. Units shall be dual duct constant air volume pneumatically actuated boxes.
2. Capacity and sizes shall be as scheduled.
3. The terminal casing shall be minimum 22 gauge galvanized steel, internally lined with dual density glass fiber insulation which complies with UL 181 and NFPA 90A.
 - a. All exposed insulation edges shall be coated with NFPA 90A approved sealant to prevent entrainment of fibers in the airstream.
 - b. The casing shall be constructed to hold leakage to the maximum value shown in Table B.
4. Cooling and heating inlets shall have separate damper assemblies for complete pressure independent control of each airstream for constant volume total discharge applications.
 - a. Terminals with inlet dampers mechanically interconnected are not acceptable.
 - b. The dampers shall be heavy gauge steel with solid shaft rotating in Derlin or bronze oilite self-lubricating bearings. Nylon bearings are not acceptable.
 - c. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable.
 - d. The damper shall incorporate a mechanical stop to prevent overstroking and a synthetic seal to limit close-off leakage to the maximum values shown in Table A.
5. Actuators shall be capable of supplying at least 35 in.-lb. Of torque to the damper shaft and shall be mounted externally for service access.
 - a. Terminals with internal actuator mounting or linkage connection must include gasketed access panel, removable without disturbing ductwork.
 - b. Casing with access panel shall be constructed to hold leakage to the maximum values shown in Table B.
6. Sound ratings for the terminal shall not exceed those scheduled.
 - a. Sound performance shall be ARI certified.

Table A

| Damper Leakage, cfm | | | |
|---------------------|---------------------|---------------------|---------------------|
| Inlet Size | 1.5" P _s | 3.0" P _s | 6.0" P _s |
| 4,5,6 | 4 | 5 | 7 |
| 7,8 | 4 | 5 | 7 |
| 7,10 | 4 | 5 | 7 |
| 12 | 4 | 5 | 7 |
| 14 | 4 | 6 | 8 |
| 16 | 5 | 7 | 9 |

Table B

| Casing Leakage, cfm | | | |
|---------------------|---------------------|---------------------|---------------------|
| Inlet Size | 1.5" P _s | 3.0" P _s | 6.0" P _s |
| 4,5,6 | 6 | 9 | 12 |
| 7,8 | 8 | 12 | 16 |
| 7,10 | 9 | 13 | 18 |
| 12 | 12 | 17 | 23 |
| 14 | 16 | 23 | 32 |

B. APPROVED MANUFACTURES

1. Trane
2. Carrier
3. Tuttle and Bailey
4. Price

PART 3 - EXECUTION

A. INSTALLATION

1. Installation shall be in strict accordance with manufacturer recommendations.

END OF SECTION 15840

SECTION 15851- DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. Furnish and install diffusers, registers, and grilles connected to ductwork as described in Contract Documents
 - 2. Quality of grilles installed in metal doors
- B. Related Sections
 - 1. Section 15051 - General Mechanical Requirements

1.2 MAINTENANCE

- A. Extra Materials - Leave tool for removing core of each different type of grille for building custodian.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- A. Ceiling Return and Transfer Grilles
 - 1. Finish - Off-white baked enamel
 - 2. 1/2 inch spacing.
 - 3. Approved Manufacturers And Models -
 - a. Price 535 or equal by
 - b. Carnes
 - c. J & J
 - d. Krueger
 - e. Metalaire
 - f. Tuttle & Bailey
 - g. Agitair
 - h. Anemostat
 - i. Barber Colman
 - j. Environmental Air Products
 - k. Air Control Products
- B. Floor Grilles
 - 1. Finish shall be brushed alluminum
 - 2. Supply grilles shall be provided with screwdriver operated opposed blade damper.
 - 3. Approved Manufacturers
 - a. Price LBP - 25B or equal by
 - b. Carnes
 - c. J & J
 - d. Kruegar

- e. Metalaire
 - f. Tuttle and Bailey
- C. Ceiling Diffusers
 - 1. Finish - Off-white baked enamel
 - 2. Approved Manufacturers And Models -
 - a. Price - SMD-6
 - b. Carnes
 - c. J & J - R-1400
 - d. Krueger - SH
 - e. Metalaire - 5500S
 - f. Tuttle & Bailey
 - g. Agitair
 - h. Anemostat
 - i. Barber Colman
 - j. Environmental Air Products
 - k. Air Control Products
 - l. Nailor

PART 3 EXECUTION

3.1 INSTALLATION

- A. Anchor securely into openings. Secure frames to ductwork by using four sheet metal screws, one per side. Level floor registers and anchor securely into floor.

3.2 ADJUSTING

- A. Set sidewall supply register blades at 15 degrees upward deflection.

END OF SECTION 15851

SECTION 15910 DDC CONTROL SYSTEM

PART 1 - GENERAL

- A. SCOPE
 - 1. Provide and install space temperature sensors to monitor space temperature only and report back to central control.
 - 2. Provide all required panels, wiring, conduit, etc to make system operable.
- B. RELATED SECTIONS
 - 1. Section 15010 and 15051 General Requirements
 - 2. Section 15920 Pneumatic Control System
 - 3. Section 15940 Sequence of Controls
 - 4. Division 16 Electrical
- C. Submittals
 - 1. Contractor shall submit for review 5 sets of wiring diagrams, panel diagrams, schematic diagrams, and equipment to be used.

PART 2 - PRODUCTS

- A. Products used in this system shall be compatible with the existing Johnson Metasis System installed on campus and in the nursing building
- B. Approved Manufacturer
 - 1. Johnson Control or equal approved by U of U Campus Planning prior to bidding.

PART 3 - EXECUTION

- A. All wiring shall be installed in accordance with the requirements of Division 16 of this specification, National Electrical Code (NEC) and routed in conduit.

END OF SECTION 15910

SECTION 15920 - PNEUMATIC CONTROL SYSTEM

PART - 1 GENERAL

A. SCOPE OF WORK-

1. Provide new thermostats to match existing with occupant adjustment, and extend pneumatic tubing to new locations.
2. Provide connections to new terminal boxes and extend pneumatic tubing to them.

B. SUBMITTALS

1. Contractor shall provide piping diagrams, schematics, and equipment catalog cuts for approval as part of submittal process.

PART - 2 PRODUCTS

- A. Tubing shall be copper or virgin polyethylene and shall match the existing system.
- B. Thermostats, controllers, etc shall be new and of the same brand or compatible with the existing system.
- C. Provide new outdoor Air Sensors to control existing boxes on the 4th floor that are serving the 5th floor area under renovation

PART - 3 EXECUTION

A. INSTALLATION

1. Contractor shall use an installer experienced in the installation of pneumatic control systems to install work.
2. Pneumatic tubing routed in walls and other inaccessible areas shall be run in conduit.

B. TESTING

1. New pneumatic tubing shall be subject to a pressure test of 1 ½ times the working pressure. Tests shall be made with any devices that may be damaged by the test pressure not connected to piping during test.

END of SECTION

SECTION 15940 - SEQUENCE OF CONTROLS

PART 1 - GENERAL

(Not Used)

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

A. SEQUENCE OF CONTROLS

1. Main System controls shall operate as existing and shall not be altered by this installation.
2. Constant volume dual duct boxes located in the ceiling space of the 5th floor shall be controlled by the existing pneumatic control system.
 - a. The space thermostat shall open and close heating and cooling dampers in the dual duct box in response to the individual room pneumatic thermostat/sensor with occupant adjustment to maintain room setpoint.
3. Existing constant volume dual duct boxes located in the 4th floor ceiling and serving 5th floor areas included in this renovation shall be controlled by an outside air sensor.
 - a. The outside air sensor shall open the heating damper to the full position when the outside air temperature drops below 40BF adjustable and shall remain open until temperature rises above outside air setpoint and then shall close.
4. Four electronic DDC Control Sensors shall be located as noted on the drawings to provide space temperature monitoring only to central Johnson Metasys control equipment.

END OF SECTION 15940

SECTION 15960 - AIR SYSTEM TEST AND BALANCE

PART 1 - GENERAL

1.1 SCOPE:

- A. Includes -
 - 1. Testing, balancing and adjusting of the following systems:
 - a. Supply and Return Air
 - b. Exhaust Air
 - 2. Test Report bound in Operating and Maintenance Manuals.
 - 3. Contractor shall make changes in pulleys, belts, motors and dampers or add dampers as required for correct balance as recommended by Air Balance & Testing Agency at no additional cost to Owner.

1.2 RELATED SECTIONS:

- A. Division 01 General and Sections 15010 and 15051 are part of this Section.

1.3 AGENCY:

- A. Contractor shall procure services of an independent Air Balance & Testing Agency which specializes in balancing and testing of heating, ventilating, and cooling systems to balance, adjust, and test air moving equipment, air distribution, and exhaust systems.
- B. Agency shall provide proof of having successfully completed at least five projects of similar size and scope and be a certified AABC or NEBB agency. Work by this Agency shall be done under direct supervision of a qualified registered professional heating and ventilating engineer employed by Agency. Agency shall maintain an office within 75 miles of project.
- C. Instruments used by Agency shall be accurately calibrated and maintained in good working order.
- D. If requested, conduct tests in presence of Architect.
- E. Agency shall be approved in writing by the Architect. Neither Engineer or anyone performing other work on this Project under Division 15 shall be permitted to do this work.
- F. Contractor shall award test and balance contract to the approved agency upon receipt of his contract to proceed to allow Agency to schedule this work in cooperation with other Sections involved and comply with completion date.
- G. Balancing agency shall be represented at final inspection meeting by qualified testing personnel with balancing equipment and two copies of the Air Balancing Test Report.
- H. Architect will choose and direct spot balancing of one zone. Differences between the spot balance and test report will be justification for requiring repeat of testing and balancing for entire project.
- I. Rebalancing shall be done in presence of Engineer and subject to his approval.
- J. Spot balance and rebalance shall be performed at no additional cost to Owner.

- K. Approved Balancing Agencies
 - 1. BTC Services
 - 2. Certified Test and Balance
 - 3. R and S Balancing

PART 3 - EXECUTION

3.1 PREPARATION

- A. Begin air balance and testing upon completion of the mechanical installation of air conditioning, ventilation, heating, exhaust systems, and controls including installation of all specialties and devices.

3.2 PROCEDURES:

- A. Before any adjustments are made, the system is to be checked for items such as dirty filters, filter leakage, major duct sections, zones, etc.
- B. Contractor shall place exhaust and ventilating systems and equipment into full operation and continue their operation during each working day of testing and balancing.
- C. Air Balance & Testing Agency shall perform tests specified, compile test data, and submit four copies of complete test data to Contractor for forwarding to Engineer for evaluation and approval.
 - 1. Approved copies of report shall be bound in Operations & Maintenance Manuals. See Division 15010 General.
- D. Systems shall be completely balanced and all reports submitted to Architect prior to test run and final inspection.
- E. System performance shall be checked when outside weather is at or near design conditions, if practicable. Heating and/or cooling thermometers or sensors shall be placed in the areas served by each fan system. Temperature readings shall be taken at half hour intervals, and further adjustments or corrections made as required to obtain uniform temperatures. All occupied spaces shall be checked for drafts and noises caused by the make-up and exhaust systems, and any unsatisfactory conditions corrected.
- F. Balancing shall be performed during normal project working hours when project construction foreman is present on the job site to provide access and see his mechanical sub contractor is available to operate system and make necessary corrections.

3.3 STANDARDS:

- A. Balance shall be performed in complete accordance with the following standards as applicable to the agency certification:
 - 1. HVAC Systems Testing, Adjusting, and Balancing, SMACNA 1983.
 - 2. Testing, Balancing, and Adjusting of Environmental Systems, SMACNA 1974.
 - 3. Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems, NEBB 1983.
 - 4. AABC National Standards, Fourth Edition 1982.

- 5. Procedural Standard for Measuring Sound and Vibration, NEBB 1977.
- B. Balancing Agency's National Certification shall warrant the system balance and performance. A copy of guarantee certificate shall be included in each test and balance report.

3.4 TESTING PROCEDURE:

- A. Air Balance & Testing Agency shall perform following tests and balance system in accordance with following requirements:
- B. Test and adjust air flow into both cold and hot deck of each dual duct box.
- C. Make Pitot Tube tranverse of main supply and obtain design cfm.
- D. Test and record system static pressures, suction, and discharge.
- E. Test and adjust system for design cfm air.
- F. Test and record entering air temperatures (db heating and cooling).
- G. Test and record entering air temperatures (wb cooling).
- H. Adjust main supply and return air ducts to proper design cfm, + or - 5%.
- I. Adjust zones to proper design cfm, supply and return, + or - 5%.
- J. Test and adjust each diffuser and grille to design requirements. Individual air outlets, when one of three or more are serving one space, may have a tolerance of 10% from the average.
- K.. Identify each diffuser and grille as to location and area served.
- L. Identify and list size, type, and Manufacturer of diffusers, grilles and testing equipment. Use Manufacturer's rating on equipment to make required calculations.
- M. In readings and tests of diffusers and grilles include required cfm and fpm velocity & test cfm and fpm after adjustments.
- H. In cooperation with Section 15 900, set adjustments of automatically operated dampers to operate as specified, indicated, or noted.
- O. Adjust diffusers and grilles to minimize drafts.

3.5 EXHAUST AIR SYSTEMS:

- A. Systems are to be adjusted to same tolerance as supply systems. Each space is to be checked to see that it is positive, neutral or negative as indicated by quantities of supply and exhaust air shown on contract documents. Any discrepancies shall be investigated and corrected, and the proper pressure relationship established.
- B. Building pressure shall be checked at outside doors, relief air damper adjusted as required to leave building neutral or under slight positive pressure.

3.6 REPORT

- A. Report shall include:
 - 1. Record test data on AABC standard forms or facsimile thereof.
 - 2. A set of black and white or blue line prints with all air openings marked to correspond with data sheets and with temperature clearly marked.
 - 3. Show on final report the percent of design CFM to the actual CFM of each diffuser represents.
 - 4. The certified report shall include for each air handling system the data listed below:

- a. Equipment
 - 1) Installation data
 - a) Manufacturer and model
 - b) Size
 - c) Arrangement, discharge, and class
 - d) Motor hp, voltage, phase, cycles, and full load amps
 - e) Location and local identification data
 - 2) Design data
 - a) Data listed in schedules on drawings and specifications.
 - 3) Fan recorded (test) data
 - a) cfm
 - b) Static Pressure
 - c) rpm
 - d) Motor operating amps
 - e) Motor operating bhp
- b. Duct systems
 - 1) Duct air quantities (maximum and minimum) - main, submains, branches, outdoor (outside) air, total air, and exhaust.
 - a) Duct size(s)
 - b) Number of Pitot tube (pressure) measurements.
 - c) Sum of velocity measurements (Note: Do not add pressure measurements)
 - d) Average velocity
 - e) Recorded (test) cfm
 - f) Design cfm
 - 2) Individual air terminals
 - a) Dual duct box number and air flow settings.
 - b) Terminal identification (supply or exhaust, location and number designation)
 - c) Type size, manufacturer and catalog identification
 - d) Applicable factor for application, velocity, area, etc., and designated area
 - e) Design and recorded velocities - fpm
 - f) Design and recorded quantities - cfm
 - g) % of design recorded quantity- cfm represents

END OF SECTION 15960

SECTION 15990 - FINAL TEST RUN

PART 1 - GENERAL

1.1 RELATED SECTIONS:

- A. Division 01 General and Sections 15010 and 15051 are part of this Section.

1.2 QUALITY CONTROL:

- A. Final inspection will not be scheduled till all tests are done and O & M's submitted.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 PROCEDURE:

- A. Contractor shall make a test run with all equipment operating continuously at design conditions for a period of 2 days or longer as necessary to demonstrate the system fulfills all requirements and operates satisfactorily. Contractor shall notify Engineer, Campus Planning and Campus System Operation personnel in writing when he is ready to begin test. Test shall be run in presence of system operation personnel and others that desire to attend. Contractor shall provide manpower to run test and operate equipment as may be required during test run. Contractor shall be responsible for all equipment during this test. The test shall run 24 hours per day with temperature control system resetting temperatures for night-day and weekends as specified.
- B. Neither the final inspection nor the final payment shall be made to the Contractor until the heating, ventilation and cooling systems operational tests have been completed, balancing reports submitted, and Owner and Engineer satisfied.
- C. Operating tests of the heating system shall be made during the winter season of the first year of operation at times directed, for the proper setting and adjusting of the controls under peak load conditions.
- D. Air Conditioning Systems: Operating test of the completed air conditioning systems shall be made during the summer season of the first year of operation at times directed. Each system shall be operated for periods of 6 hours minimum; test for air flow and temperature, to demonstrate compliance with required plans and specifications.
- E. Recalibrate fresh air, return air and mixed air controls in areas effected by the renovation.
- F. Furnish copies of test data, computation, results, as directed.
- G. Applicable requirements under air conditioning tests shall govern similar work in heating, unless otherwise specified.
- H. Temperature Controls: Manufacturer of automatic controls shall regulate and adjust thermostats, and other controlling devices; he shall place control systems in satisfactory operating conditions; he shall also instruct assigned operating personnel in operation and maintenance of these controls. Furnish diagrammatic layouts of automatic control systems, and two sets of printed instructions for Owners operation and maintenance charts.

- I. When final adjustments have been made, temperature readings shall be taken at a minimum of half hour intervals for a three hour period minimum. All damper positions shall be marked and access covers replaced.

END OF SECTION 15990

SECTION 16000 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 16.

1.2 SUMMARY

- A. This Section includes general requirements for electrical installations. The following requirements are included in this Section to expand the requirements specified in Division 1:
 - 1. Summary of work.
 - 2. Project Coordination.
 - 3. References and Standards.
 - 4. Industry Standards.
 - 5. Submittals.
 - 6. Substitutions.
 - 7. Temporary Facilities.
 - 8. Materials and Equipment.
 - 9. Summary Test Report.
 - 10. Warranties.
 - 11. Permits.

1.3 SUMMARY OF WORK

- A. General: Follow the summary specified in Division 1 Section "SUMMARY OF WORK." Visit site prior to submitting proposal and inspect all existing features that will affect Div 16 work. Include alterations and coordination with existing work. Review requirements of Owner for phasing and partial occupancy prior to substantial completion of work. The work will be conducted to provide the least possible interference to the activities of the Owner's personnel and operations.
- B. The work consists of, but is not limited to, the construction of:
 - 1. Complete branch circuit wiring system for lighting, motors, receptacles, junction boxes, and similar uses.
 - 2. Motor controllers, disconnects, and associated equipment.
 - 3. Lighting fixtures, wiring devices, and similar items.
 - 4. Raceways for Auxiliary systems whether auxiliary system is installed under this or separate contracts. Plywood backboards or other mounting structures for auxiliary systems.

5. Connection of heating and ventilating equipment.
 6. Connection of motors and electrically operated equipment.
 7. Emergency lighting systems.
 8. Fire alarm.
 9. Lighting Control Equipment.
- C. A separate contract has been issued for:
1. Furnishing and installing telephone\data instruments and cabling.
- D. Prenegotiated purchase orders: The Owner has negotiated purchase orders as indicated in the contract documents with suppliers of material and equipment to be incorporated into the Work. These purchase orders are assigned to the installer and costs for receiving, handling, storage, if required, and installation are included in the Contract Sum.
1. The Installer's responsibilities are the same as if the Installer negotiated purchase orders, including responsibility to renegotiate purchase if necessary and to execute final purchase order agreements.
- E. Owner furnished items: The Owner will furnish material and equipment as indicated in the contract documents to be incorporated into the Work. These items are assigned to the installer and costs for receiving, handling, storage, if required, and installation are included in the Contract Sum.
1. The Installer's responsibilities are the same as if the Installer furnished the materials or equipment.
 2. The Owner will arrange and pay for delivery of Owner-furnished items FOB job site and the installer will inspect deliveries for damage. If Owner-furnished items are damaged, defective or missing, document damaged items with the transport company and the Owner will arrange for replacement. The Owner will also arrange for manufacturer's field services, and the delivery of manufacturer's warranties and bonds to the Installer.
 3. The Installer is responsible for designating the delivery dates of Owner-furnished items and for receiving, unloading and handling Owner- furnished items at the site. The Installer is responsible for protecting Owner-furnished items from damage, including damage from exposure to the elements, and to repair or replace items damaged as a result of his operations.

1.4 PROJECT COORDINATION

- A. General: Follow the requirements specified in Division 1 Section "PROJECT COORDINATION." Well in advance of installation of every major unit of work which requires coordination and interfacing with other work, meet at project site with installers and representatives of manufacturers and fabricators who are involved in or affected by unit of work and in its coordination and integration with other work which has

preceded or will follow. Do not proceed with the work if associated pre-installation conference cannot be concluded successfully. Instigate actions to resolve impediments to performance of the work. Preinstallation conferences are required for:

1. Division 15 installers - Review division 15 shop drawings and compare with loads shown on equipment schedule. Determine whether lighting fixtures and other electrical items are shown to conflict with location of structural members and mechanical or other equipment. Determine whether Div 15 equipment encroaches on clearances required by NEC.
2. Telephone/Data Installer - Coordinate facilities for telephone installation with Owner's telephone vendor.
3. Systems Furniture Installer - Coordinate with the Owner's furniture installer the wiring configuration, connection requirements, and dimensional layout of the furniture to be provided. Determine whether proposed furniture design will interface with electrical design as shown. Notify Architect/Engineer of any discrepancy.

1.5 REFERENCE STANDARDS AND DEFINITIONS

- A. General: Basic Contract definitions are included in the General Conditions.
- B. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.
- C. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.
- D. Approve: The term "approved," where used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in General and Supplementary Conditions.
- E. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."
- G. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."

- H. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."
- I. Installer: An "Installer" is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor, for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
- J. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions."

1.6 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.
- C. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to the Architect/Engineer for a decision before proceeding.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Refer uncertainties to the Architect/Engineer for a decision before proceeding.
 - 2. Clarification methods: At the time of bidding, bidders shall familiarize themselves with the drawings and specifications. Any questions, misunderstandings, conflicts, deletions, discontinued products, catalog number discrepancies, discrepancies between the equipment supplied and the intent or function of the equipment, etc., shall be submitted to the Architect/Engineer in writing for clarification prior to issuance of the final addendum and bidding of the project. Where discrepancies or multiple interpretations occur, the most stringent (which is generally recognized as the most costly) that meets the intent of the documents shall be enforced.
- D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity.

Copies of applicable standards are not bound with the Contract Documents. The following addresses and telephone numbers is supplemental to the standards listed in Division 1.

| | |
|-------|---|
| ANSI | American National Standards Institute 11 West 42nd Street, 13th Floor New York, NY 10036 (212) 642-3300 |
| ASTM | American Society for Testing and Materials 1916 Race St. Philadelphia, PA 19103 (215) 299-5400 |
| CBM | Certified Ballast Manufacturers Association 1422 Euclid Ave. Hanna Building, Suite 772 Cleveland, OH 44115 (216) 241-0711 |
| EIA | Electronic Industries Assoc. 2001 Pennsylvania Ave., NW, Suite 1100 Washington, DC 20006 (202) 457-4900 |
| ETL | ETL Testing Laboratories, Inc. P.O. Box 2040 Route 11, Industrial Park Cortland, NY 13045 (607) 753-6711 |
| ICEA | Insulated Cable Engineers Association Inc. P.O. Box 440 South Yarmouth, MA 02664 (617) 394-4424 |
| IEC | International Electrotechnical Commission (Available from ANSI) 1430 Broadway New York, NY 10018 (212) 354-3300 |
| IEEE | Institute of Electrical and Electronic Engineers 345 E. 47th St. New York, NY 10017 (212) 705-7900 |
| IESNA | Illuminating Engineering Society of North America 120 Wall St. FL 17 New York, NY 10005 (212) 248-5000 |

| | | |
|------|--|----------------|
| LPI | Lightning Protection Institute P.O. Box 1039 Woodstock, IL 60098 | (815) 337-0277 |
| NEC | National Electric Code (Now NFPA) | |
| NECA | National Electrical Contractors Association 7315 Wisconsin Ave., Suite 1300 W Bethesda, MD 20814 | (301) 657-3110 |
| NEMA | National Electrical Manufacturers Association 2101 L St., NW, Suite 300 Washington, DC 20037 | (202) 457-8400 |
| NFPA | National Fire Protection Association One Batterymarch Park PO Box 9101 Quincy, MA 02269-9101 | (617) 770-3000 |
| UL | Underwriters Laboratories 333 Pfingsten Rd. Northbrook, IL 60062 | (708) 272-8800 |
| FS | Federal Specification (from GSA) Specifications Unit (WFSIS) 7th and D St., SW Washington, DC 20407 | (202) 708-9205 |

1.7 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Section "SUBMITTALS." As a minimum, all data shall be submitted in a suitable three ring binder or binders labeled as to project, date, and installer. Include Installers' signature indicating his unqualified approval that the equipment will fit in the space shown, and is complete with all requirements of the plans and specifications. Provide space for Architect "Action" marking. Do not proceed without appropriate Architect's "Action" marking. Allow 2 weeks for review.
- B. Action Stamp: The Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:
 1. Final Unrestricted Release: Where submittals are marked "Approved," that part of the Work covered by the submittal may proceed provided it complies with

requirements of the Contract Documents; final acceptance will depend upon that compliance.

2. Final-But-Restricted Release: When submittals are marked "Approved as Noted," that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
3. Returned for Resubmittal: When submittal is marked "Not Approved, Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
 - a. Do not permit submittals marked "Not Approved, Revise and Resubmit" to be used at the Project site, or elsewhere where Work is in progress.
4. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "Action Not Required".

1.8 SUBSTITUTIONS

- A. Substitution Request Submittal: Requests for substitution may be considered or rejected at the discretion of the Architect/Engineer.
 1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and in accordance with procedures required for Change Order proposals.
 2. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
 - a. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
 - b. Samples, where applicable or requested.
 - c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as electrical characteristics, photometrics, size, weight, durability, performance and visual effect.
 - d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors, that will become necessary to accommodate the proposed substitution.
 - e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the

substitution. Indicate the effect of the proposed substitution on overall Contract Time.

- f. Cost information, including a proposal of the net change, if any in the Contract Sum.
- g. Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time, that may subsequently become necessary because of the failure of the substitution to perform adequately.

1.9 TEMPORARY FACILITIES

- A. General: Temporary facilities are specified in Division 1 and include but are not limited to:
 - 1. Temporary electric power and light.
 - 2. Telephone service.
- B. Standards:
 - 1. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service in compliance with National Electric Code (NFPA 70).

1.10 MATERIALS AND EQUIPMENT

- A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.
- B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.
 - 1. If a dispute arises between prime Contractors over concurrently selectable, but incompatible products, the Architect/Engineer will determine which products shall be retained and which are incompatible and must be replaced.

1.11 SUMMARY TEST REPORT

- A. Prepare summary test report in accordance with the requirements in Division 1 Section "PROJECT CLOSEOUT." Make all tests required by the authorities having jurisdiction, by the Architect and his consultants, and the Owner. In addition to the requirements specified in Division 1 and individual sections of the specifications, make tests of the indicate installed conditions for:
 - 1. Include tests from final punchlist. Refer to section 16010.

2. Voltage and ammeter readings at the time of substantial completion: for all feeders, and the main service to the facility at the point of load termination. If there are any abnormal conditions, they shall be brought to the attention of the Engineer in writing as a part of this submittal.

1.12 WARRANTY REQUIREMENTS

- A. In addition to the requirements of Division 1 and other sections of this specification, warranty for a minimum of one year (except two months for lamps) after date of substantial completion all Division 16 work.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- C. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty.
- D. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- E. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefitted from use of the Work through a portion of its anticipated useful service life.
- F. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- G. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.14 PERMITS, FEES

- A. Obtain and pay all city, state, or local ordinance electrical permits and inspections before beginning construction.
- B. Pay electric, telephone, and cable TV fees or reimbursable construction costs to the utilities in a timely manner so as not to delay construction.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.
- B. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.
- C. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.

2.2 PRODUCT SELECTION

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.
 - 1. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.
 - 2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include the following:

1. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.
2. Semiproprietary Specification Requirements: Where two or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted.
 - a. Where products or manufacturers are specified by name, accompanied by the term "or equal," or "or approved equal" comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
3. Non-Proprietary Specifications: When the Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product is specified for a specific application.
 - a. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.
6. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.
7. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily.
 - a. Where no product available within the specified category matches satisfactorily and also complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category, or for noncompliance with specified requirements.

8. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern and texture from the product line selected.

2.3 SUBSTITUTIONS

- A. Conditions: The Contractor's substitution request will be received and considered by the Architect/Engineer when one or more of the following conditions are satisfied, as determined by the Architect/Engineer; otherwise requests will be returned without action except to record noncompliance with these requirements.
 1. Extensive revisions to Contract Documents are required.
 2. Proposed changes are in keeping with the general intent of Contract Documents.
 3. The request is timely, fully documented and properly submitted.
4. The request is directly related to an "or equal" clause or similar language in the Contract Documents.
5. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly, or an unwillingness to pay special freight or factory charges to reduce the time of manufacturing.
6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
7. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.
8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
9. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provide the required warranty.
11. Where a proposed substitution involves more than one prime Contractor, each Contractor shall cooperate with the other Contractors involved to coordinate the Work, provide uniformity and consistency, and to assure compatibility of products.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS

- A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
- C. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
- D. Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.
- E. Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.
- F. Recheck measurements and dimensions, before starting each installation.
- G. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
- H. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
- I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

3.2 CLEANING AND PROTECTION

- A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

- C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.3 TEMPORARY FACILITIES

- A. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload protected disconnects, automatic ground-fault interrupters and main distribution switch gear.
 - 1. Except where overhead service must be used, install electric power service underground.
 - 2. Power Distribution System: Install wiring overhead, and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, AC 20 ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.
- B. Temporary Lighting: Whenever overhead floor or roof deck has been installed, provide temporary lighting with local switching.
 - 1. Install and operate temporary lighting that will fulfill security and protection requirements, without operating the entire system, and will provide adequate illumination for construction operations and traffic conditions.
- C. Temporary Telephones: Provide temporary telephone service for all personnel engaged in construction activities, throughout the construction period. Install telephone on a separate line for each temporary office and first aid station. Where an office has more than two occupants, install a telephone for each additional occupant or pair of occupants.
 - 1. At each telephone, post a list of important telephone numbers.

3.4 PROJECT CLOSEOUT

- A. General: Refer to Section 16010 for final punchlist requirements.
- B. Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
 - 1. Maintenance manuals.
 - 2. Record documents.
 - 3. Spare parts and materials.
 - 4. Tools.

5. Lubricants.
 6. Identification systems.
 7. Control sequences.
 8. Hazards.
 9. Cleaning.
 10. Warranties and bonds.
 11. Maintenance agreements and similar continuing commitments.
- C. As part of instruction for operating equipment, demonstrate the following procedures:
1. Start-up.
 2. Shutdown.
 3. Emergency operations.
 4. Noise and vibration adjustments.
 5. Safety procedures.
 6. Economy and efficiency adjustments.
 7. Effective energy utilization.
- D. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
 - a. Remove labels that are not permanent labels.
 - b. Clean transparent materials. Replace chipped or broken lenses and other damaged transparent materials.
 - c. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition.
 - d. Wipe surfaces of electrical equipment. Remove excess lubrication and other substances. Clean light fixtures and lamps.

END OF SECTION 16000

SECTION 16010 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 16.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:
 - 1. Submittals.
 - 2. Coordination drawings.
 - 3. Record documents.
 - 4. Maintenance manuals.
 - 5. Rough-ins.
 - 6. Electrical installations.
 - 7. Cutting and patching.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 15 Section "ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT," for factory-installed motors, disconnects, controllers, accessories, connections, and automatic temperature control wiring.
 - 2. Division 16 Section "BASIC ELECTRICAL MATERIALS AND METHODS," for materials and methods common to the remainder of Division 16, plus general related specifications including:
 - a. Access to electrical installations.
 - b. Excavation for electrical installations within the building boundaries and from building to utility connections.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer licensed for the work to be performed in the state and/or locality in which the work is performed. Licenses shall be carried at all times and shown upon request.
- B. DFCM Compliance: Comply with the latest edition of "DESIGN CRITERIA" as adopted by the Utah State Building Board.
- C. University of Utah Compliance: Comply with the latest edition of "University of Utah, Design Standards" as prepared by University of Utah Campus Design & Construction.

1.4 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Section "SUBMITTALS."
- B. Increase, by the quantity listed below, the number of electrical related shop drawings, product data, and samples submitted, to allow for required distribution plus one copies of each submittal required, which will be retained by the Electrical Consulting Engineer;

however, in no case shall less than 8 total copies be submitted for shop drawings and product data.

1. Shop Drawings: 1 additional blue- or black-line prints.
2. Product Data: 1 additional copy of each item.

C. Additional copies may be required by individual sections of these Specifications.

1.5 COORDINATION DRAWINGS

- A. Prepare coordination drawings in accordance with Division 1 Section "PROJECT COORDINATION," to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
1. Where deviations from contract documents are proposed, submit proposed changes prior to proceeding with the work.

1.6 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1 Section "PROJECT CLOSEOUT." Maintain during the course of construction a blue-line set of contract drawings and shop drawings in clean, undamaged condition, with mark-up of actual installations which vary substantially from the work originally shown. Mark with red erasable pencil. Mark-up new information which is recognized to be of importance to Owner, but was for some reason not shown the drawings. Give particular attention to concealed work, which would be difficult to measure and record at a later date. In addition to the requirements specified in Division 1, indicate installed conditions for:
1. Redline changes or information from construction set.
 2. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.7 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1 Section "PROJECT CLOSEOUT"; however, in no case shall fewer than 3 maintenance manuals in three ring binders be provided. In addition to the requirements specified in Division 1, include the following information for equipment items:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 ROUGH-IN

- A. Since the drawings of floor and ceiling installations are made at a small scale, outlets, devices, equipment, etc., are indicated only in their approximate location. Do not scale electrical drawings. Refer to the architectural and mechanical drawings and dimensions. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.2 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
 1. Coordinate electrical systems, equipment, and materials installation with other building components. Verify electrical requirements including voltage, full load amps, minimum wire ampacity of equipment requiring electrical connection prior to installing or purchasing associated equipment and wiring. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Wherever possible, mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment. Notify Architect of any discrepancy.
 2. Verify all dimensions by field measurements.
 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 8. Coordinate and obtain written approval from Owner's representative at least 7 days in advance for electrical service interruption.
 9. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination

- requirements conflict with individual system requirements, refer conflict to the Architect.
10. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 11. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
 12. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "ACCESS DOORS" and Division 16 Section "BASIC ELECTRICAL MATERIALS AND METHODS."
 13. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 14. Install outlets not dimensioned according to the Architectural elevations. Otherwise, locate according to Architect's instructions. The right is reserved to make any reasonable changes in the locations indicated without additional cost.

3.3 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1 Section "CUTTING AND PATCHING." In addition to the requirements specified in Division 1, the following requirements apply:
 1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - a. Uncover Work to provide for installation of ill-timed Work.
 - b. Remove and replace defective Work.
 - c. Remove and replace Work not conforming to requirements of the Contract Documents.
 - d. Remove samples of installed Work as specified for testing.
 - e. Install equipment and materials in existing structures.
 - f. Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.
 2. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.
 3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
 4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
 6. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
 - a. Refer to Division 1 Section "DEFINITIONS AND STANDARDS" for definition of experienced "Installer."
 7. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer

to the materials and methods required for the surface and building components being patched.

- a. Refer to Division 1 Section "DEFINITIONS AND STANDARDS" for definition of experienced "Installer."

3.4 FINAL PUNCHLIST

- A. General: In addition to the requirements of Division 1 for substantial completion, include the following:

1. DFCM Requirements: Before final acceptance a DFCM representative shall test all wiring systems with the assistance of the architect and electrical consultant's representative, with all lamps, motors, appliances and equipment in place and in good working condition. The entire construction shall test free of mechanical and electrical defects.
2. University of Utah Requirements: Before final acceptance a University of Utah Electric Shop representative shall test all wiring systems with the assistance of the architect and electrical consultant's representative, with all lamps, motors, appliances and equipment in place and in good working condition. The entire construction shall test free of mechanical and electrical defects.
3. Prerequisite personnel for electrical final punchlist:

- a. Electrical project engineer must be present.
- b. Electrical installer job foreman must be present.
- c. DFCM electrical specialist must be present.
- d. University of Utah electrical specialist must be present.
- e. Fire Alarm manufacturer representative must be present.
- f. Fire Marshall or authority having jurisdiction must be present.
- g. Additional personnel may be required by other sections of this specification.

4. Other prerequisites for electrical final punchlist:
 - a. List of incomplete items, value of incompleteness, and reasons for being incomplete.
 - b. Submit record drawings, record specifications, maintenance manuals, warranties, and summary test report.
 - c. Deliver tools, spare parts, extra stocks of materials, and similar physical items to Owner. Provide delivery receipt signed by Owner's representative.
 - d. Complete start-up testing of systems and instructions of Owner's operating/maintenance personnel.
 - e. Main panel/switchboard shall be open.
 - f. Clear access shall be provided to all devices and equipment.
 - g. Provide a chart indicating heater type - size and rating - for all MCC units, starter combination units.
 - h. All panels and disconnects shall be labeled per plans and specifications with typed index cards indicating specific circuit locations.
 - i. All light fixtures shall be on and operating.
 - j. Installer shall have pad and pencil to list all deficient items noted.
 - k. All corrections and adjustments shall be done after the inspection, not during. These items will appear on the final punch list.
 - l. Required keys for panels and doors.

5. Prerequisites for fire alarm final punchlist: refer to Section 16721.

6. Comply with other prerequisites as specified in other sections of the specification.

END OF SECTION 16010

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements specified in Division 16 Section "Basic Electrical Requirements" apply to this Section.

1.2 SUMMARY

- A. This Section includes limited scope general construction materials and methods for application with electrical installations as follows:
 - 1. Selective demolition including:
 - a. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
 - b. Dismantling electrical materials and equipment made obsolete by these installations.
 - 2. Miscellaneous metals for support of electrical materials and equipment.
 - 3. Wood grounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment.
 - 4. Joint sealers for sealing around electrical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
 - 5. Access panels and doors in walls, ceilings, and floors for access to electrical materials and equipment.
 - 6. Painting of electrical materials and equipment.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer for the installation and application joint sealers, access panels, and doors.
- B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide UL listed assemblies to maintain specified rating where electrical or electrical components penetrate rated assemblies. Refer to manufacturers listed in the UL "Building Materials Directory" for rating shown. Products include, but are not limited to:
 - 1. Access doors.
 - 2. Conduit penetrations.
 - 3. Floor outlets, pokethru outlets.
 - 4. Lighting fixture "tents".

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

- B. Store and handle joint sealer materials in compliance with the manufacturers' recommendations to prevent their deterioration and damage.

1.5 PROJECT CONDITIONS

- A. Conditions Affecting Selective Demolition: The following project conditions apply:
 - 1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
 - 2. Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- B. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

1.6 SEQUENCE AND SCHEDULING

- A. Coordinate the shut-off and disconnection of electrical service with the Owner and the utility company.
- B. Notify the Architect at least 5 days prior to commencing demolition operations.
- C. Perform demolition in phases as indicated.

1.7 PAINTING

- A. Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available.
 - 1. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of electrical equipment.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.

- F. Fasteners: Zinc-coated, type, grade, and class as required.

2.2 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPB rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
- B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 3/4 inches and painted with suitable fire rated paint material where required.

2.3 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

2.4 ACCESS DOORS

- A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
- B. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - 1. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
 - 2. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - 3. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- C. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 - 1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
- D. Locking Devices: Where indicated, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.
- E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bar-Co., Inc.

2. J.L. Industries.
3. Karp Associates, Inc.
4. Milcor Div. Inryco, Inc.
5. Nystrom, Inc.

2.5 PAINTING: Refer to Division 9 section "Painting"

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION FOR JOINT SEALERS

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.3 SELECTIVE DEMOLITION

- A. General: Demolish, remove, demount, and disconnect abandoned electrical materials and equipment indicated to be removed and not indicated to be salvaged or saved. Coordinate with other work, including electrical wiring work, as necessary to interface installation of existing equipment with other work. New electrical equipment and apparatus shall be coordinated and connected into the existing systems. Relocate existing electrical devices, conduit and/or equipment that for any reason obstructs construction. All electrical equipment and apparatus in the building not remodeled shall be connected and remain in working condition. Include any equipment having electrical connections that requires disconnecting and reconnection at the same or another location throughout the course of construction.
- B. Materials and Equipment To Be Salvaged: Remove, demount, and disconnect existing electrical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
 1. Coordinate with the owner during demolition to determine which demolished items are to be salvaged and return to the owner. The owner has ownership rights to all demolished equipment and materials. Remove and legally dispose of all other demolished equipment and materials.
 2. The existing lighting fixtures shall be carefully removed and turned over to the Owner at a location on site which he has selected. Those fixtures indicated for reuse shall be thoroughly cleaned, repaired as required, relamped and installed as indicated.
- C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged. Lamps containing mercury must be disposed of in compliance with state and federal regulations, at no additional cost or liability to the owner.

- D. Electrical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
 - 1. Inactive and obsolete raceway systems, controls, and fixtures.
 - a. Raceways embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove materials above accessible ceilings.
 - 2. Vacated or unused circuits shall have wire pulled out of raceway back to the branch panel or first active outlet. All circuits, conduit and wire that are not used in the remodeling shall be removed back to the panelboard unless noted otherwise.
 - 3. Perform cutting and patching required for demolition in accordance with Division 1 Section "Cutting and Patching." Obtain permission from the architect before penetrating any ceiling, floor, and wall surfaces.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.
- D. Install 4' X' X 3/4" plywood terminal boards in enclosures or mounted on walls as indicated.

3.6 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 - 2. Comply with recommendations of ASTM C 790 for use of acrylic- emulsion joint sealants.
- B. Tooling: Immediately after sealant application and prior to time shining or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

- C. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.7 INSTALLATION OF ACCESS DOORS

- A. Where access units are required in compliance with NEC obtain approval from the Architect prior to installing equipment requiring access units.
- B. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- C. Adjust hardware and panels after installation for proper operation.

3.8 PAINTING: Refer to Division 9 section "Painting".

END OF SECTION 16050

SECTION 16100 - RACEWAYS, BOXES, AND CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Raceways include the following:
 - 1. Rigid metal conduit.
 - 2. Intermediate metal conduit.
 - 3. Electrical metallic tubing (EMT).
 - 4. Flexible metal conduit.
 - 5. Liquidtight flexible conduit.
 - 6. Wireway.
- C. Boxes, enclosures, and cabinets include the following:
 - 1. Device boxes.
 - 2. Outlet boxes.
 - 3. Pull and junction boxes.
- D. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 7 Section "Firestopping."
 - 2. Division 16 Section "Supporting Devices" for raceway and box supports.
 - 3. Division 16 Section "Cable Trays."

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for surface raceway, wireway and fittings, floor boxes, hinged cover enclosures, and cabinets.
- C. Voice/Data Installer Coordination Letter: Submit coordination letter cosigned by local telephone company, telephone interconnect company and raceway installer that the raceway installation shown on the drawings shall be adequate for the equipment installation contemplated.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
- C. Comply with NECA "Standard of Installation."
- D. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide Products by of one of the following:
 1. Metal Conduit and Tubing:
 - a. Monogram Co., AFC.
 - b. Alflec Corp.
 - c. Allied Tube and Conduit, Grinnell Co.
 - d. Anamet, Inc., Anaconda Metal Hose.
 - e. Anixter Brothers, Inc.
 - f. Carol Cable Co., Inc.
 - g. Cole-Flex Corp.
 - h. Flexcon, Inc., Coleman Cable Systems, Inc.
 - i. Spiraduct, Inc.
 - j. Triangle PWC, Inc.
 - k. Wheatland Tube Co.
 2. Conduit Bodies and Fittings:
 - a. Scott Fetzer Company, Adalet-PLM.
 - b. American Electric, Construction Materials Group.
 - c. Emerson Electric Co., Appleton Electric Co.
 - d. Carlon.
 - e. Hubbell, Inc., Killark Electric Manufacturing Co.
 - f. General Signal, O-Z/Gedney Unit.
 - g. Spring City Electrical Manufacturing Co.
 3. Wireway:
 - a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.
 4. Boxes, Enclosures, and Cabinets:
 - a. Scott Fetzer Company, Adalet-PLM.
 - b. Butler Manufacturing Co., Walker Division.
 - c. Cooper Industries, Midwest Electric.
 - d. Electric Panelboard Co., Inc.
 - e. Erickson Electrical Equipment Co.
 - f. American Electric, FL Industries.
 - g. Hoffman Engineering Co., Federal-Hoffman, Inc.
 - h. Hubbell Inc., Killark Electric Manufacturing Co.
 - i. General Signal, O-Z/Gedney.
 - j. Parker Electrical Manufacturing Co.

- k. Raco, Inc., Hubbell Inc.
- l. Robroy Industries, Inc., Electrical Division.
- m. Spring City Electrical Manufacturing Co.
- n. Square D Co.
- o. Thomas & Betts Corp.
- p. Woodhead Industries, Inc., Daniel Woodhead Co.

2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Intermediate Metal Conduit: ANSI C80.6.
- C. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
- D. Plastic-Coated Intermediate Metal Conduit and Fittings: NEMA RN 1.
- E. Electrical Metallic Tubing and Fittings: ANSI C80.3 with set-screw or compression-type fittings, except that indenter-type and die-cast fittings shall not be provided.
- F. Flexible Metal Conduit: Zinc-coated steel.
- G. Liquidtight Flexible Metal Conduit: Flexible steel conduit with PVC jacket.
- H. Fittings: NEMA FB 1, compatible with conduit/tubing materials.

2.3 WIREWAYS

- A. Material: Sheet metal sized and shaped as indicated.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireway as required for complete system.
- C. Select features where not otherwise indicated, as required to complete wiring system and to comply with NEC.
- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

2.4 OUTLET AND DEVICE BOXES

- A. Sheet Metal Boxes: NEMA OS 1.
- B. Cast Metal Boxes: NEMA FB 1, type FD, cast ferrous alloy box with gasketed cover.

2.5 PULL AND JUNCTION BOXES

- A. Small Sheet Metal Boxes: NEMA OS 1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance

of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

- A. General: Install all wiring in conduit unless specifically indicated otherwise.
- B. Outdoors: Use the following wiring methods:
 - 1. Exposed: Rigid or intermediate metal conduit.
 - 2. Concealed: Rigid or intermediate metal conduit.
 - 3. Underground, Single Run: Rigid nonmetallic conduit or rigid steel conduit wrapped or coated, except that bends greater than 22 degrees shall be rigid metal.
 - 4. Underground, Grouped: Rigid nonmetallic conduit or rigid steel conduit wrapped or coated, except that bends greater than 22 degrees shall be rigid metal.
 - 5. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquidtight flexible metal conduit.
 - 6. Boxes and Enclosures: NEMA Type 3R or Type 4.
 - 7. Underground penetration of foundations: provide rigid conduit wrapped or coated sleeves wherever conduit penetrates foundations that extends a minimum of 3' from foundations to protect conduits from shearing during settling of foundations.
- C. Indoors: Use the following wiring methods:
 - 1. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Flexible metal conduit, except in wet or damp locations, or where subject to dripping oil or grease, use liquidtight flexible metal conduit.
 - 2. Damp or Wet Locations: Rigid steel conduit or Intermediate metal conduit.
 - 3. Exposed: Electrical metallic tubing, intermediate metal conduit, rigid metal conduit.
- 4. Concealed: Electrical metallic tubing, intermediate metal conduit.
 - 5. Boxes and Enclosures: NEMA Type 1, except in damp or wet locations use NEMA Type 4, stainless steel.
- D. Note: Do not install plastic conduit above grade or to penetrate structural elements.

3.3 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Minimum size conduit:

| | |
|------------------|------|
| EMT, Rigid, IMC | 3/4" |
| Low voltage | 3/4" |
| Flexible conduit | 3/4" |
- C. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors, except in equipment rooms and unfinished storage spaces. In existing facilities, conceal wiring except where approval for the use of surface raceway has been received by the Architect. Do not install lighting raceway in equipment rooms until piping and ductwork are completed.

- D. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.
- E. Install raceways level and square and at proper elevations. Provide adequate headroom. Where possible, install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Support raceway as specified in Division 16 Section "Supporting Devices."
- H. Use temporary closures to prevent foreign matter from entering raceway. Conduits in which water or foreign matter has been permitted to accumulate shall be thoroughly cleaned or the conduit replaced where such accumulation cannot be removed by methods approved by the Architect.
- I. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel. Field bends and offsets shall be made without flattening, kinking, rippling or destroying the smooth internal bore or surface of the conduit and to not less than NEC minimum radius. Conduit that shows signs of rippling or kinking shall not be installed.
- J. Use raceway fittings compatible with raceway and suitable for use and location. For rigid and intermediate steel conduit, use threaded rigid steel conduit fittings, except as otherwise indicated.
- K. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated. For EMT, use Type 1 for raintight connections, Type 2 for concrete tight connections, and Type 3 for other miscellaneous connections. For flexible conduit and liquidtight flexible conduit utilize Type 1 connections. Provide expansion fittings on all raceway runs that cross building expansion joints (OZ type AX). For conduits 1" and larger install OZ type "B" connectors.
- L. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated. This does not apply to conduits in crawl spaces.
- M. Provide suitable coating or wrapping for metal conduit through floor, concrete and/or earth.
- N. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
 - 1. Run parallel or banked raceways together, on common supports where practical.
 - 2. Make bends in parallel or banked runs from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.
- O. Join raceways with fittings designed and approved for the purpose and make joints tight.
 - 1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 - 2. Use insulating bushings to protect conductors.

- P. Tighten set screws of threadless fittings with suitable tool. Discard fittings without full set of screws.
- Q. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box. Provide connectors for 1" or larger conduits with insulated throats or plastic bushings. Provide double lock nuts and plastic bushings for IMC and rigid conduit. Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box. Provide grounding bushings for all service conduit and conduits installed in concentric/eccentric knock-outs or reducing washers.
- R. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
- S. Install raceways in maximum lengths at 150 feet and with a maximum of four 90-deg bends or equivalent. Install independently supported pull or junction boxes where necessary to comply with these requirements.
- T. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb (90 kg) tensile strength. Leave not less than 12 inches (300 mm) of slack at each end of the pull wire.
- U. Telephone and Signal System Raceways 2-Inch Trade Size and Smaller: In addition to the above requirements, install in maximum lengths of 150 feet (45 m) and with a maximum of two 90-deg bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.
- V. Install flashings for conduits which penetrate roofing. Comply with flashing requirements of other sections of this specification. This work shall be performed under the direct supervision of the subcontractor responsible for flashing, if any.
- W. Install raceway sealing fittings according to the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:
 - 1. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.
 - 2. Where otherwise required by the NEC.
- X. Seal conduits with a mastic any conduit which pierces airtight spaces or plenums.
- Y. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches (150 mm) above the floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush flush with floor.
- Z. Flexible Connections: Use maximum of 6 feet (1830 mm) of flexible conduit for recessed and Semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit

- in wet or damp locations. Install separate ground conductor across flexible connections.
- AA. PVC Externally Coated Rigid Steel Conduit: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduit.
- AB. Conduit bodies shall not contain splices.
- AC. Install from each section of each branch panel five spare 3/4" conduits (capped) into the ceiling and floor space. When the floor space is not accessible, run six into the ceiling.
- AD. Coordinate installation of telephone raceway system components with voice/data cabling installers.
- AE. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.
- AF. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated. Outlet boxes shall not be less than 4" X 4" X 1 1/2". Outlet boxes for mounting lighting fixtures shall not be less than 4" octagonal. Where three or more conduit entrances are made, use a minimum box depth of 2-1/8". Provide gang boxes where more than one switch or device is located at one point. Sectional boxes shall not be used. Provide suitable plaster rings to match finish materials to set flush with finished surfaces. In masonry wall where a tile or plaster ring cannot be used, install a single gang 3 1/2" deep box minimum.
- AG. Remove sharp edges where they may come in contact with wiring or personnel.
- AH. Set floor boxes level and adjust to floor surface. In slabs on grade and wet locations use NEMA type 4 boxes. At other locations in slabs, use concrete-tight NEMA 1 boxes.
- AI. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.
- AJ. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:
1. Interior Dry Locations: Sheet steel, NEMA type 1.
 2. Locations Exposed to Weather or Dampness: Cast metal, NEMA type 3R.
 3. Wet Locations: NEMA type 4 enclosures.
- AK. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location. Raceway shall not be installed in a single continuous run in excess of 150' without installing a pull box. Where pull boxes are not indicated, Installer shall select possible locations and obtain approval from Architect prior to proceeding.
- AL. Install boxes in locations to ensure ready accessibility of electrical wiring.
- AM. Outlets at Windows and Doors: Locate close to window trim. For outlets indicated above doors use 6' - 9" mounting height above finished floor and center outlets above the door opening except as otherwise indicated.

- AN. Column and Pilaster Locations: Locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions.
- AO. Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.
- AP. Gasketed Boxes: At the following locations use cast metal, threaded hub type boxes with gasketed weatherproof covers:
1. Exterior locations.
 2. Where surface mounted on unfinished walls, columns or pilasters. (Cover gaskets may be omitted in dry locations).
 3. Where exposed to moisture laden atmosphere.
 4. Where indicated.
- AQ. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Dimensions are to the center of boxes mounted on walls. Mount boxes for receptacles either vertically or horizontally but consistently either way. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side. Install boxes with rigid supports using metal bar hangers, or 2" X 4" wood bridging between studs with screws. Welding boxes directly to metal joist and studs is not acceptable. Boxes set opposite in wall shall have at least 10" of conduit between them.
- AR. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4-inches round by 1-1/2-inches deep, minimum. Where three or more entrances are made, use minimum box depth of 2 1/8" deep. Where fixtures are to be installed, provide with standard 3/8" stud. Outlets for recessed fixtures in acoustical tile ceilings shall be located to center on a single tile or at the intersection of four tiles.
- AS. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.
- AT. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.
- AU. Existing Outlet Boxes: Where extension rings are required to be installed, drill new mounting holes in the rings to align with the mounting holes on the existing boxes where existing holes are not aligned.
- AV. Box Selection: J-boxes with 4 or more conduits shall be minimum size of 4 11/16". For boxes in main feeder conduit runs, use sizes not smaller than 8-inches square by 4-inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed the following:

| Size of Largest Conductors in Box | Maximum no. of Conductors in Box |
|--|---|
| No. 4/0 AWG | 30 |
| 250 MCM | 20 |

| | |
|--------------|----|
| 500 MCM | 15 |
| Over 500 MCM | 10 |

1. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30-inches inside boxes.
2. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling.
3. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

3.5 CLEANING

- A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 16100

SECTION 16111 - CABLE TRAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes cable trays and accessories.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 7 Section "Firestopping."
 - 2. Division 16 Section "Supporting Devices" for cable tray supports not specified in this Section.

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each component. Show tray types, dimensions, and finishes.
- C. Shop drawings detailing fabrication and installation of cable tray, including plans, elevations, sections, details of components, and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice plates connectors, expansion joint assemblies, straight lengths, and fittings.
- D. Coordination drawings, including floor plans and sections drawn to accurate scale. Show accurately scaled cable tray layout and relationships between components and adjacent structural and mechanical elements.
- E. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.
- F. Factory certified test reports of specified products, conforming to NEMA VE 1.
- G. Field test reports indicating and interpreting test results relative to compliance with performance requirements specified in "Field Quality Control" Article of this Section.
- H. Maintenance data for cable tray, for inclusion in "Operating and Maintenance Manual" specified in Division 1. Include detailed manufacturer's instructions on tightening connections.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Select a firm experienced in manufacturing cable trays similar to those indicated for this Project and which has a record of successful in-service performance.

- B. Comply with NFPA 70, "National Electrical Code" for components and installation.
- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
- D. Single-Source Responsibility: All cable tray components shall be the product of a single manufacturer.

1.5 SEQUENCING AND SCHEDULING

- A. Coordination: Coordinate layout and installation of cable tray with other installations.
 - 1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide cable trays manufactured by one of the following:
 - 1. B-Line Systems, Inc.
 - 2. Chalfant Manufacturing Co.
 - 3. GS Metals Corp.
 - 4. MP Husky Corp.
 - 5. Mono-Systems, Inc.
 - 6. P-W Industries, Inc.
 - 7. Cablofil, CF54 series.
 - 8. GS Metals, Flex-tray.

2.2 MATERIALS AND FINISHES

- A. Cable Trays, Fittings, and Accessories: Aluminum or carbon steel wire mesh type. Provide seismic bracing. Cable tray type with center spine and rungs only attached at the center spine is not allowed.
- B. Protect steel hardware against corrosion by galvanizing conforming to ASTM B 633 or cadmium plating conforming to ASTM B 766.
- C. Fabricate cable tray products with rounded edges and smooth surfaces.

2.3 SIZES AND CONFIGURATIONS

- A. Ladder-Type Trays:
 - 1. Width: 12 inches (152 mm).
 - 2. Inside Depth: 4 inches (102 mm).
 - 3. Cross-Rung Spacing: 6 inches (305 mm) o.c. or less for wire mesh type.
 - 4. Minimum Fitting Radius: 12 inches (305 mm).

2.4 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, manufactured with the same materials and finishes as the cable trays.
- B. Barrier Strips: Same materials and finishes as cable trays.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer. Cable tray shall be side hung type.

2.5 FIRESTOPPING

- A. Materials: UL listed and labeled and FM approved for fire ratings consistent with penetrated barriers.
- B. Sleeves: Schedule 40, welded, black steel pipe sleeves. Sizes as indicated or minimum NEC size for cable or cable group to be installed.
- C. Sealing Fittings: Suitable for sealing cables in sleeves or core drilled holes.
- D. Sealing Pillows: Suitable for sealing cable penetration slots/openings in fire barriers.

2.6 SOURCE QUALITY CONTROL

- A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive cable tray for compliance with installation tolerances and other required conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

- A. Use cable tray of indicated types and sizes, complete with manufacturer's recommended covers, barrier strips, dropouts, fittings, conduit adapters, hold-down devices, grommets, and blind ends.

3.3 INSTALLATION

- A. Install cable tray level and plumb according to manufacturer's written instructions, rough-in drawings, the original design, and referenced standards.
- B. Remove burrs and sharp edges of cable trays.
- C. Fasten cable tray supports securely to the building structure as specified in Division 16 Section "Supporting Devices" unless otherwise indicated.
 - 1. Locate and install supports according to recommendations of NEMA VE 1.
 - 2. Design supports, including fastenings to the structure, to carry the greater of the calculated load multiplied by a safety factor of 4, or the calculated load plus 200 lbs (90 kg).
 - 3. Provide seismic bracing appropriate for the seismic zone where the project is located.

- D. Make connections to equipment with flanged fittings fastened to the tray and to the equipment. Support the tray independently of fittings. Do not carry the weight of the tray on the equipment enclosure.
- E. Install expansion connectors in cable tray runs that exceed 90 feet (27 m). Space connectors and set gaps according to NEMA VE 1.
- F. Make changes in direction and elevation using standard fittings.
- G. Make cable tray connections using standard fittings.
- H. Locate cable tray above piping except as required for tray accessibility and as otherwise indicated.
- I. Firestop penetrations through fire and smoke barriers according to Division 7 Section "Firestopping."
- J. Firestop penetrations through fire and smoke barriers, including walls, partitions, floors, and ceilings, after cables are installed.
- K. Sleeves for Future Cables: Install capped sleeves for future cables through firestopped cable tray penetrations of fire and smoke barriers.
- L. Working Space: Install cable trays with sufficient space to permit access for installing cables.
- M. Install barriers to separate cables of different systems, such as power, communications, and data processing, or different insulation levels, such as 600 V, 5,000 V, and 15,000 V.
- N. Install covers after installation of cable is completed.

3.4 GROUNDING

- A. Connect cable trays to ground as instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.5 FIELD QUALITY CONTROL

- A. Grounding: Test cable trays to ensure electrical continuity of bonding and grounding connections.
- B. Correct malfunctioning units at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.6 CLEANING

- A. Upon completion of installation of system, including fittings, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes, including chips, scratches, and abrasions.

3.7 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer to ensure that the cable tray is without damage or deterioration at Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by the tray manufacturer.

END OF SECTION 16111

SECTION 16120 - WIRES AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600 volts and less.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 7 Section "Firestopping."
 - 2. Division 16 Section "Supporting Devices" for supports and anchors for fastening cable directly to building finishes.
 - 3. Division 16 Section "Electrical Identification" for insulation color coding and wire and cable markers.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
 - 1. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
- C. UL Compliance: Provide components which are listed and labeled by UL under the following standards.
 - 1. UL Std. 83 Thermoplastic-Insulated Wires and Cables.
 - 2. UL Std. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- D. IEEE Compliance: Provide components which comply with the following standard.
 - 1. Std. 82 Test procedures for Impulse Voltage Tests on Insulated Conductors.

1.4 SEQUENCING AND SCHEDULING

- A. Coordination: Coordinate layout and installation of cable with other installations.
 - 1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire and cable according to NEMA WC-26.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wires and Cables:
 - a. American Insulated Wire Corporation, Leviton Manufacturing Co.
 - b. Brand-Rex Cable Systems, Brintec Corp.
 - c. Carol Cable Company, Inc.
 - d. Senator Wire & Cable Co.
 - e. Southwire Co.
 - 2. Connectors for Wires and Cables:
 - a. AFC, Monogram Co.
 - b. AMP, Inc.
 - c. Anderson, Square D Co.
 - d. Electrical Products Division, 3M Co.
 - e. O-Z/Gedney Unit, General Signal.

2.2 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Applications" Article.
- B. Rubber Insulation: Conform to NEMA WC 3.
- C. Thermoplastic Insulation: Conform to NEMA WC 5.
- D. Solid conductor for 10 AWG and smaller; stranded conductor for larger than 10 AWG.

2.3 CONNECTORS AND SPLICES

- A. UL-listed factory-fabricated wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated. Select to comply with Project's installation requirements and as specified in Part 3 "Applications" Article.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Branch Circuits (minimum size #12): Type THHN/THWN, copper conductor, in raceway; except, that premanufactured wiring may be utilized for wiring lighting fixtures in accessible ceilings.

- B. Branch Circuits in fluorescent fixtures (minimum size #12): Type THHN/THWN, copper conductor, 90C insulation.
- C. Flexible pendant leads to outlets or equipment: Type SO cord.
- D. Fire Alarm Circuits: Type THHN/THWN, copper conductor, in raceway; except twisted shielded pair in raceway where required for data or communication lines.
- E. Class 1 Control Circuits (minimum #14): Type THHN/THWN, copper conductor, in raceway.
- F. Class 2 Control Circuits: Type THHN/THWN, copper conductor, in raceway.

3.3 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and the NECA "Standard of Installation."
- B. Coordinate cable installation with other Work. For multi-wire branch circuits, install no more than three circuits in a raceway, unless specifically shown otherwise.
- C. Conceal all cable in finished spaces.
- D. Branch circuits for which the distance from panelboard to furthest outlet, when measured along the conductor is more than 100' for 120 volt or more than 140' for 277 volts circuits, install minimum #10 wire.
- E. Provide separate neutrals for all GFI circuit breakers.
- F. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than no 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.
- G. Carefully measure parallel conductors to ensure that they are the same length. In no case shall parallel conductors be less #1/0. A full size ground shall be installed in all parallel conduits.
- H. Remove existing wire from raceway before pulling in new wire and cable.
- I. Pull conductors into raceway simultaneously where more than one is being installed in same raceway.
 - 1. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
 - 2. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- J. Conductor Splices: Keep to minimum.
 - 1. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
 - 2. Use splice and tap connectors that are compatible with conductor material.
- K. Wiring at Outlets: Install with at least 12 inches (300 mm) of slack conductor at each outlet.
- L. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts,

according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

3.4 FIELD QUALITY CONTROL

- A. Testing: Upon installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled.
- C. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.
- D. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.
- E. Correct malfunctioning products at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

END OF SECTION 16120

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes various types of receptacles, connectors, switches, and finish plates.

1.3 SUBMITTALS

- A. Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each product specified.
- C. Samples of devices and device plates for color selection and evaluation of technical features.
- D. Operation and maintenance data for materials and products specified in this Section to include in the "Operating and Maintenance Manual" specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for devices and installation.
- B. Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.
 - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.

1.5 COORDINATION

- A. Wiring Devices for Owner Furnished Equipment: Match devices to plug connectors for Owner-furnished equipment.
- B. Cord and Plug Sets: Match cord and plug sets to equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:

- a. See "Standard Wiring Device Schedule".
- 2. Poke-Through:
 - a. See "Standard Wiring Device Schedule".

2.2 WIRING DEVICES

- A. Comply with NEMA Standard WD 1, "General Purpose Wiring Devices."
- B. Enclosures: NEMA 1 equivalent, except as otherwise indicated.
- C. Device and Plate Finishes: Single and combination types that mate and match with corresponding wiring devices. Features include the following:
 - 1. Color: Matches wiring device except as otherwise indicated.
 - 2. Plate-Securing Screws: Metal with heads colored to match plate finish.
- 3. Material for Finished Spaces: Color selection by Architect, except as otherwise indicated, from standard lexan or nylon finishes: Brown, Ivory, White, Gray or metal finishes.
- 4. Material for Unfinished Spaces: Galvanized steel with Ivory devices.
- D. Standard Receptacles, Straight-Blade and Locking Type: Provide nylon or lexan face, and where available, back and side wiring. Except as otherwise indicated, comply with Federal Specification W-C-596 and heavy-duty grade of UL Standard 498, "Electrical Attachment Plugs and Receptacles." Provide NRTL labeling of devices to verify these compliances.
- E. Standard Receptacles, Straight-Blade, Special Features: Comply with the basic requirements specified above for straight-blade receptacles of the class and type indicated, and with the following additional requirements:
 - 1. Ground-Fault Circuit Interrupter (GFCI) Receptacles: UL Standard 943, "Ground Fault Circuit Interrupters," feed-through type, with integral NEMA 5-20R duplex receptacle arranged to protect connected downstream receptacles on the same circuit. Design units for installation in a 2-3/4-inch (70-mm) deep outlet box without an adapter. Provide decorator style nylon or lexan face side wired.
- F. Receptacles, Industrial Heavy-Duty: Conform to NEMA Standard PK 4 "Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type for Industrial Use."
- G. Cord and Plug Sets: Match voltage and current ratings and number of conductors to requirements of the equipment being connected.
 - 1. Cord: Rubber-insulated, stranded copper conductors, with type SOW-A jacket. Grounding conductor has green insulation. Ampacity is equipment rating plus 30 percent minimum.
 - 2. Plug: Male configuration with nylon body and integral cable-clamping jaws. Match to cord and to receptacle type intended for connection.
- H. Standard Snap Switches: Quiet-type A.C. switches, NRTL listed and labeled as complying with UL Standard 20 "General Use Snap Switches," and with Federal Specification W-S-896.
- I. Dimmer Switches: Modular full-wave solid-state units with integral, quiet on-off switches, and audible and electromagnetic noise filters.

1. Wattage rating exceeds connected load by 30 percent minimum, except as otherwise indicated.
2. Control: Continuously adjustable slide. Single-pole or 3-way switch to suit connections.
3. Incandescent Lamp Dimmers: Modular dimmer switches for incandescent fixtures; switch poles and wattage as otherwise indicated, 120 V, 60 Hz with continuously adjustable slide, single-pole with soft tap or other quiet switch. Equip with electromagnetic filter to eliminate noise, RF and TV interference, and 5-inch (127-mm) wire connecting leads.
4. Low Voltage Incandescent Lamp Dimmers: Modular dimmer switches for incandescent fixtures; switch poles and wattage as otherwise indicated, 120 V, 60 Hz with continuously adjustable slide, single-pole with soft tap or other quiet switch. Equip with DC current protective device, electromagnetic filter to eliminate noise, RF and TV interference, and 5-inch (127-mm) wire connecting leads.

2.3 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -prewired assembly of below-floor junction box unit with multichanneled, through-floor raceway/firestop unit and detachable mating floor service outlet assembly as specified above. Features include the following:
 1. Size: Selected to fit nominal 3-inch (75-mm) cored holes in the floor and matched to the floor thickness.
 2. Fire Rating: Unit is listed and labeled to match the fire rating of the floor.
 3. Closure Plug: Arranged to close unused 3-inch (75-mm) cored openings and reestablish the fire rating of the floor.
4. Combination power outlet and voice/data: Three No. 12 AWG power and ground conductors to NEMA 5-20R duplex with spring return closures, and two openings for voice/data cables as specified. Brass coverplate.
5. Combination furniture power connection and voice/data: Eight No. 12 AWG power and ground conductors to threaded connection for furniture whips; two openings for voice/data cables as specified.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Except as otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- D. Protect devices and assemblies during painting.
- E. Adjust locations at which floor service outlets, poke-thru, and telephone/power service poles are installed to suit the indicated arrangement of partitions and furnishings.
- F. Provide a GFCI outlet at all locations where shown on plans. Feed through wiring not allowed unless specifically indicated on plans.

3.2 IDENTIFICATION

- A. Comply with Division 16 Section "Electrical Identification."

3.3 FIELD QUALITY CONTROL

- A. Testing: Test wiring devices for proper polarity and ground continuity. Operate each operable device at least 6 times.
- B. Test ground-fault circuit interrupter operation with both local and remote fault simulations according to manufacturer recommendations.
- C. Replace damaged or defective components.

3.4 CLEANING

- A. General: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 16140

| Standard Wiring Device Schedule Note to Bidders: Comply with Section 16140 of the specifications. The catalog numbers listed below have been carefully prepared with the assistance of the manufacturer's representatives with the objective of assisting the bidders in determining the quality and ratings of the wiring device specified; however, the catalog numbers may not be complete or accurate. In addition, the color of the wiring device is not intended to be determined by the catalog numbers listed below, but shall be selected by the Architect as indicated in the specification. Each manufacturer prior to bidding shall compare catalog numbers shown with the description and shall notify the Architect/Engineer of any discrepancies. | | |
|--|---|--|
| NEMA 5-20R | 20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498. | Bryant 5352 Hubbell CR5352 Leviton 5352 P&S 5352 |
| NEMA 5-20R GFCI | 20A, 125V 2 pole 3 wire duplex feed thru GFCI receptacles with indicator light. Nylon or Lexan decorator faces. Back and side wired. Internal components shall comply with FS W-C-596 where applicable. Comply with UL 498 and UL 493. | Bryant GFR53FT Hubbell GF5352 Leviton 6898 P&S 2091 S |
| NEMA 5-20R Waterproof (Weatherproof in use) | 20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498. Fully gasketed weatherproof while in use enclosure. | Hubbell CR5352/5051-0 |
| NEMA 5-20R Weatherproof | 20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498. Cast aluminum and UL listed for wet locations. | Hubbell HBL5206WO |
| 20A SINGLE POLE | 20A single pole 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V. | Hubbell CS1221 Leviton 1221 P & S 521 Bryant 4901 |
| 20A THREE-WAY | 20A three-way 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V. | Hubbell CS1223 Leviton 1223 P & S 523 Bryant 4903 |
| 20A FOUR-WAY | 20A four-way 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V. | Hubbell CS1224 Leviton 1224 P & S 524 Bryant 4904 |
| POKETHRU DUPLEX RECEPTACLE WITH 2 CAT 5 JACKS PT1 | Fire rated poke-thru: duplex receptacle with spring loaded lift cover flaps and 2 Category 5 data jacks. Thru floor fitting shall fit in 3" diameter hole and shall be rated for floor penetrated. Provide carpet flange. Brass coverplate. | Hubbell PT7FBR3SL Walker RC3ATCBS |

| | | |
|---|---|--|
| POKETHRU FURNITURE POWER WITH TWO CABLE OPENINGS PT2 | Fire rated poke-thru: 8-wire furniture connection and 2 cable openings for 6PR cables. Thru floor fitting shall fit in 3" diameter hole and shall be rated for floor penetrated. Provide carpet flange. Coordinate coverplate color w/ architect. | Hubbell PT73FFSDX Walker RC7AFTCX |
| INCANDES- CENT DIMMER, 1000W | 1000W 120 V incandescent dimmer switches: Modular full-wave solid-state units with integral, quiet on-off switches, and audible and electromagnetic noise filters. Wattage rating exceeds connected load by 30 percent minimum, except as otherwise indicated. Continuously adjustable slide. Single pole or 3-way to suit connections. 5" leads. | Hubbell AS10 P & S 91080 or P & S 91083 |
| INCANDES- CENT DIMMER, 1500W | 1500W 120 V incandescent dimmer switches: Modular full-wave solid-state units with integral, quiet on-off switches, and audible and electromagnetic noise filters. Wattage rating exceeds connected load by 30 percent minimum, except as otherwise indicated. Continuously adjustable slide. Single pole or 3-way to suit connections. 5" leads. | Hubbell AS15 P & S 91580 or P & S 91583 |
| INCANDES- CENT DIMMER, 2000W | 2000W 120 V incandescent dimmer switches: Modular full-wave solid-state units with integral, quiet on-off switches, and audible and electromagnetic noise filters. Wattage rating exceeds connected load by 30 percent minimum, except as otherwise indicated. Continuously adjustable slide. Single pole or 3-way to suit connections. 5" leads. | Hubbell AS20 P & S 92080 |

SECTION 16190 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements of the following Division 16 Sections apply to this section:
 - 1. "Basic Electrical Requirements."
 - 2. "Basic Electrical Materials and Methods."

1.2 SUMMARY

- A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.
- B. Related Sections: The following Sections contains requirements that relate to this Section:
 - 1. Division 3 Section "Concrete Accessories" for inserts, anchors, and sleeves to be installed in concrete for use with supporting devices.
 - 2. Division 5 Section "Metal Fabrications" for requirements for miscellaneous metal items involved in supports and fastenings.
 - 3. Division 7 Section "Joint Sealers" for requirements for firestopping at sleeves through walls and floors that are fire barriers.
 - 4. Refer to other Division 16 sections for additional specific support requirements that may be applicable to specific items.

1.3 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- B. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Slotted Metal Angle and U-Channel Systems:
 - a. Allied Tube & Conduit
 - b. American Electric
 - c. B-Line Systems, Inc.
 - d. Cinch Clamp Co., Inc.
 - e. GS Metals Corp.
 - f. Haydon Corp.

- g. Kin-Line, Inc.
 - h. Unistrut Diversified Products
- 2. Conduit Sealing Bushings:
 - a. Bridgeport Fittings, Inc.
 - b. Cooper Industries, Inc.
 - c. Elliott Electric Mfg. Corp.
 - d. GS Metals Corp.
 - e. Killark Electric Mfg. Co.
 - f. Madison Equipment Co.
 - g. L.E. Mason Co.
 - h. O-Z/Gedney
 - i. Producto Electric Corp.
 - j. Raco, Inc.
 - k. Red Seal Electric Corp.
 - l. Spring City Electrical Mfg. Co.
 - m. Thomas & Betts Corp.
- 3. Seismic Bracing:
 - a. Mason Industries, Inc.
 - b. Korfund.
 - c. Amber/Booth.

2.2 COATINGS

- A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

2.3 MANUFACTURED SUPPORTING DEVICES

- A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
- B. Fasteners: Types, materials, and construction features as follows:
 - 1. Expansion Anchors: Carbon steel wedge or sleeve type.
 - 2. Toggle Bolts: All steel springhead type.
 - 3. Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for the intended service.
- C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
- D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.
- E. U-Channel Systems: 16-gage steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

2.4 FABRICATED SUPPORTING DEVICES

- A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
- B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
- C. Pipe Sleeves: Provide pipe sleeves of one of the following:
 - 1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:
 - a. 3-inch and smaller: 20-gage.
 - b. 4-inch to 6-inch: 16-gage.
 - c. over 6-inch: 14-gage.
 - 2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
 - 3. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

2.5 SEISMIC BRACING

- A. General: Provide vibration isolators, flexible connections, rigid steel frames, concrete inertia bases, anchors, inserts, hangers, and attachments, seismic bracing and snubbers as required for seismic control and prevention of the transmission of vibration for both isolated and non-isolated systems.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
- B. Coordinate with the building structural system and with other electrical installation.
- C. Raceway Supports: Comply with the NEC and the following requirements:
 - 1. Conform to manufacturer's recommendations for selection and installation of supports. Do not support conduit from ceiling support wires or by wire wrapped around pipe.
 - 2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.
 - 3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
 - 4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
 - 5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter

- or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
6. Space supports for raceway types not covered herein in accordance with NEC.
 7. Support exposed and concealed raceway within 1 foot of couplings, fittings, an unsupported box and access fittings. Provide minimum 2 supports per ten foot run. Support each 90 degree bend. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
 8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
 9. Bracing shall be parallel to trusses, beams, joists, bridging, etc.
 10. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work. The installation of electrical work shall not interfere with the removal of ceiling tiles, the service of mechanical equipment, etc.
- D. Vertical Conductor Supports: Install simultaneously with installation of conductors.
- E. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
- F. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.
- G. Sleeves: Install in concrete slabs and walls and all other fire- rated floors and walls for raceways and cable installations. For sleeves through fire rated-wall or floor construction, apply UL- listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with "Fire Resistant Joint Sealers" requirement of Division 7 Section "Joint Sealers."
- H. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.
- I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:
1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
 2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
 3. Do not install wooden plugs inserted in concrete or masonry units as a base for anchoring.

4. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock- resistant fasteners for attachments to concrete slabs.
 5. Do not install drilled in anchors of any type in prestressed or post-tensioned concrete slabs and beams without approval from Architect.
 6. Toggle bolts, moly bolts or screws in sheetrock or plaster or tie wire are not acceptable as a support means for any equipment.
- J. SEISMIC REQUIREMENTS: Comply with seismic requirements for the proper seismic zone for electrical equipment and conduits 2 inch or larger.
1. Vibration isolated equipment shall be mounted on rigid steel frames or concrete bases. Each spring mounted base shall have a minimum of four all directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. The snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications.
 2. Non-isolated equipment shall be installed according to UBC Sec. 2312 (g); Cp Factor Table 23J, I Factor Table 23K.4.C In addition, the vertical forces restrain requirements shall be computed as the $\frac{1}{2}$ the value of the horizontal forces.

END OF SECTION 16190

SECTION 16195 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements of the following Division 16 Sections apply to this section:
 - 1. "Basic Electrical Requirements."
 - 2. "Basic Electrical Materials and Methods."

1.2 SUMMARY

- A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:
 - 1. Buried electrical line warnings.
 - 2. Identification labeling for raceways, cables, and conductors.
 - 3. Equipment labels and signs.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 9 Section "Painting" for related identification requirements.
- C. Refer to other Division 16 sections for additional specific electrical identification associated with specific items.

1.3 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. American Labelmark Co.
 - 2. Calpico, Inc.
 - 3. Cole-Flex Corp.
 - 4. Emed Co., Inc.
 - 5. George-Ingraham Corp.
 - 6. Ideal Industries, Inc.
 - 7. Kraftbilt
 - 8. LEM Products, Inc.
 - 9. Markal Corp.
 - 10. National Band and Tag Co.
 - 11. Panduit Corp.

12. Radar Engineers Div., EPIC Corp.
13. Seton Name Plate Co.
14. Standard Signs, Inc.
15. W.H.Brady, Co.

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.
- B. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in 1/4" high white letters on black face and punched for mechanical fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.
- B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.
- C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- D. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes. In addition, all fire alarm junction boxes shall be painted red.
- E. Underground Electrical Line Identification: During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground plastic line marker, located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
- F. Install line marker for underground wiring, both direct-buried and in raceway.
- G. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

| <u>208/120 Volts</u> | <u>Phase</u> |
|----------------------|--------------|
| Black | A |
| Red | B |
| Blue | C |
| White | Neutral |
| Green | Ground |

Switch legs, travelers and other wiring for branch circuits shall be of colors other than those listed above.

- H. Use conductors with color factory-applied the entire length of the conductors except as follows:
 - 1. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
 - a. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
 - b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.
- I. Power Circuit Identification: Securely fasten identifying metal tags or aluminum wraparound marker bands to cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms with 1/4-inch steel letter and number stamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-lb test monofilament line or one-piece self-locking nylon cable ties.
- J. Tag or label conductors as follows:
 - 1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
 - 2. Multiple Circuits: Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure (except for three-circuit, four-wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
 - 3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- K. Install equipment/system circuit/device identification as follows:
 - 1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/4-inch-high lettering on 1-inch-high label (1 1/2-inch-high where two lines are required), white lettering in black field. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.

- a. Panelboards (exterior and interior), electrical cabinets, and enclosures. For subpanels, identify feeder circuit from which served.
 - b. Access doors and panels for concealed electrical items.
 - c. Motor starters, including circuit origination, HP, heater size, and FLA.
 - d. Disconnect switches.
 - e. Pushbutton stations.
 - f. Control devices.
 - g. Fire alarm master station or control panel.
- L. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.
- M. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION 16195

SECTION 16452 - GROUNDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements of the following Division 16 Sections apply to this Section:
 - 1. "Basic Electrical Requirements."
 - 2. "Basic Electrical Materials and Methods."

1.2 SUMMARY

- A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 16 Section "Wires and Cables."

1.3 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code" (NEC).
- C. UL Standard: Comply with UL 467, "Grounding and Bonding Equipment."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Anixter Bros., Inc.
 - 2. Bashlin Industries, Inc.
 - 3. Buckingham Mfg. Co.
 - 4. A.B. Chance Co.
 - 5. Dossert Corp.
 - 6. Engineered Products Co.
 - 7. Erico Products, Inc.
 - 8. Galvan Industries, Inc.
 - 9. GB Electrical, Inc.
 - 10. General Machine Products Co., Inc.
 - 11. Hastings Fiber Glass Products, Inc.

12. Ideal Industries, Inc.
13. Kearney-National.
14. McGill Mfg.
15. O-Z/Gedney Co.
16. Raco, Inc.
17. Thomas & Betts Corp.
18. W.H. Salisbury & Co.
19. Utilco Co.

2.2 GROUNDING AND BONDING PRODUCTS

- A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- B. Conductor Materials: Copper.

2.3 WIRE AND CABLE CONDUCTORS

- A. General: Comply with Division 16 Section "Wires and Cables." Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
- B. Equipment Grounding Conductor: Green insulated.
- C. Grounding Electrode Conductor: Stranded cable.
- D. Bare Copper Conductors: Conform to the following:
 1. Solid Conductors: ASTM B-3.
 2. Assembly of Stranded Conductors: ASTM B-8.
 3. Tinned Conductors: ASTM B-33.

2.4 MISCELLANEOUS CONDUCTORS

- A. Ground Bus: Bare annealed copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.
- C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.5 CONNECTOR PRODUCTS

- A. General: Listed and labeled as grounding connectors for the materials used.
- B. Pressure Connectors: High-conductivity-plated units.
- C. Bolted Clamps: Heavy-duty units listed for the application.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.

1. Install separate insulated equipment grounding conductors with circuit conductors for the following in addition to those locations where required by Code:
 - a. Lighting circuits.
 - b. Receptacle Circuits.
 - c. Single-phase motor or appliance circuits.
 - d. Three-phase motor or appliance branch circuits.
 2. Nonmetallic Raceways: Install an insulated equipment ground conductor in nonmetallic raceways unless they are designated for telephone or data cables.
 3. Flexible conduit in excess of six feet: Install an insulated equipment ground conductor in flexible conduit in excess of six feet.
 4. Air Duct Equipment Circuits: Install an insulated equipment grounding conductor to duct-mounted electrical devices operating at 120-V and above including air cleaners and heaters. Bond the conductor to each such unit and to the air duct.
- B. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicated.
- C. Signal and Communications: For telephone, alarm, and communication systems, provide a #6 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location.

3.2 INSTALLATION

- A. General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.
- B. Remodeling: In areas where electrical renovation is indicated, ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.
- C. Metal Structural Frame: Provide insulated copper ground conductors, sized as indicated, in conduit from the building main service equipment, or the ground bus, to the metal structural frame. Bond the ground conductor conduit to the conductor at each end.
- D. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
- E. Bond interior metal piping systems and metal air ducts to equipment ground conductors of pumps, fans, electric heaters, and air cleaners serving individual systems.

3.3 CONNECTIONS

- A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
 2. Make connections with clean bare metal at points of contact.

3. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
 4. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.
- B. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.
- C. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.
- D. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.
- E. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

END OF SECTION 16452

SECTION 16470 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements of the following Division 16 Sections apply to this Section:
 - 1. "Basic Electrical Requirements."
 - 2. "Basic Electrical Materials and Methods."

1.2 SUMMARY

- A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V or less.

1.3 DEFINITIONS

- A. Load Center: A panelboard with thermal magnetic circuit-breaker branches, primarily of the plug-in type, designed for residential and light commercial projects, operating at 240 V and below, available in both single and 3-phase versions, and equipped with combination flush/surface mounting trim.
- B. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type panelboard, accessory item, and component specified.
- C. Shop drawings from manufacturers of panelboards including dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:
 - 1. Enclosure type with details for types other than NEMA Type 1.
 - 2. Bus configuration and current ratings.
 - 3. Short-circuit current rating of panelboard.
 - 4. Layout of overcurrent protective devices spaces as specified.
 - 5. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
- 6.Spare Fuse Cabinets: Show materials, dimensions, and features including storage provisions for fuse cartons.
- D. Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer-installed and field-installed wiring.
- E. Report of field tests and observations.
- F. Panel schedules for installation in panelboards.

- G. Maintenance data for panelboard components, for inclusion in Operating and Maintenance Manual specified in Division 1 and in Division 16 Section "Basic Electrical Requirements." Include instructions for testing circuit breakers.

1.5 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
- B. Product Selection for Restricted Space: The Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and items. Panelboards having equal performance characteristics and complying with indicated maximum dimensions may be considered.
- C. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- D. NEMA Standard: Comply with NEMA PB1, "Panelboards."
- E. UL Standards: Comply with UL 61, "Panelboards," and UL 50, "Cabinets and Boxes."

1.6 EXTRA MATERIALS

- A. Keys: Furnish six spares of each type for panelboard cabinet locks.
- B. Touch-up Paint for surface-mounted panelboards: One half-pint container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Square D Co.

2.2 PANELBOARDS, GENERAL REQUIREMENTS

- A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Tandem circuit breakers shall not be used. Multipole breakers shall have common trip. Placed in panel as shown on plans.
- B. Enclosures: Cabinets, flush or surface mounted as indicated. NEMA Type 1 enclosure, except where the following enclosure requirements are indicated.
- C. Front: Secured to box with concealed trim clamps except as indicated. Front for surface-mounted panels shall be same dimensions as box. Fronts for flush panels shall overlap box except as otherwise specified.
- D. Directory Frame: Metal, mounted inside each panel door.
- E. Buses and Connections: Three-phase, four-wire except as otherwise indicated. Features as follows:

1. Phase and Neutral Bus Material: Hard-drawn copper of 98 percent conductivity.
 - a. Where bus is copper, use copper for feeder circuit-breaker line connections.
 2. At load terminals of feeder breakers, provide silver-plated copper bus extensions equipped with pressure terminal connectors for outgoing circuit conductors.
 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors and of same material as phases bus. Bonded to box.
 4. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.
 5. Contact Surfaces of Buses: Silver plated.
 6. Main Phase Buses, Neutral Bus, and Equipment Ground Bus: Uniform capacity the entire length of the switchboard main and distribution sections. Provide for future extensions from either end where indicated by means of bolt holes or other approved method and connecting links.
 7. Neutral Buses: 100 percent of the ampacity of the phase buses except as indicated and equipped with approved pressure connector terminations for outgoing circuit neutral cables.
- F. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.
- G. Special Features: Provide the following features for panelboards:
1. Hinged Front Cover: Entire front trim hinged to box with standard door within hinged trim cover.
 2. Subfeed: OCPD or lug provision as indicated.

2.3 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

- A. Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Double-Width Panels: Where more than 42 poles are indicated or where otherwise indicated, provide two panelboards under single front.
- C. Doors: In panel front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.

2.4 IDENTIFICATION

- A. General: Refer to Division 16 Section "Electrical Identification" for labeling materials.
- B. Panelboard Nameplates: Engraved laminated plastic nameplate for each panelboard mounted on the interior and exterior with epoxy or industrial cement or industrial adhesive.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.
- B. Mounting Heights: Top of trim 6'-2" above finished floor, except as indicated.
- C. Location: Examine areas where panelboards are planned to be installed. Coordinate with other installers so that installation will not violate clearances of NEC 384-4. Panels shall not be located behind room doors (hinged side).
- D. Mounting: Plumb and rigid without distortion of box. Mount flush panels uniformly flush with wall finish.
- E. Circuit Directory: Typed and reflective of final circuiting. Final building room numbers (not architectural room numbers) shall be used to identify locations. Obtain approval before installing.
- F. Install filler plates in unused spaces.
- G. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties. Do not splice in panelboards.

3.2 IDENTIFICATION

- A. Identify field-installed wiring and components and provide warning signs in accordance with Division 16 Section "Electrical Identification."

3.3 GROUNDING

- A. Connections: Make equipment grounding connections for panelboards as indicated.
- B. Provide ground continuity to main electrical ground bus indicated.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Pretesting: Upon completing installation of the system, perform the following preparations for tests:
 - 1. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.
 - 2. Make continuity tests of circuits.
 - 3. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
- B. Quality Control Program: Conform to the following:

1. Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.
 2. Report written reports of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.
 3. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating results of tests and inspections, responsible organization and person, and date.
- C. Visual and Mechanical Inspection: Include the following inspections and related work:
1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
 2. Exercise and perform of operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 3. Check panelboard mounting, area clearances, and alignment and fit of components.
 4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 5. Perform visual and mechanical inspection and related work for overcurrent protective devices.
- D. Electrical tests: Include the following items performed in accordance with manufacturer's instruction:
1. Insulation resistance test of buses and portions of control wiring that disconnected from solid-state devices. Insulation resistance less than 100 megohms is not acceptable.
 2. Test main and subfeed overcurrent protective devices in accordance with Section "Overcurrent Protective Devices."
- E. Retest: Correct deficiencies identified by tests and observations and provide retesting of panelboards by testing organization. Verify by the system tests that the total assembly meets specified requirements.

3.6 CLEANING

- A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION 16470

SECTION 16475 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fuses.

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each fuse type. Include the following:
 - 1. Descriptive data and time-current curves.
 - 2. Let-through current curves for fuses with current limiting characteristics.
 - 3. Coordination charts and tables and related data.
 - 4. Fuse size for elevator feeder and disconnect applications.
- C. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.
- D. Field test reports indicating and interpreting test results.
- E. Maintenance data for tripping devices to include in the "Operating and Maintenance Manual" specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
- C. Single-Source Responsibility: All fuses shall be the product of a single manufacturer.

1.5 EXTRA MATERIALS

- A. Furnish the following extra materials that match products installed, packaged with protective covering for storage, and with identification labels clearly describing contents.
- B. Spare Fuses: Furnish quantity equal to 20 percent of each fuse type and size installed, but not less than 1 set of 3 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide fuses by one of the following:
 - 1. Brush Fuses, Inc.
 - 2. Bussmann Div., Cooper Industries, Inc.
 - 3. Circuit Protection Div.; Gould, Inc.
 - 4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1 nonrenewable cartridge fuse, class as specified or indicated, current rating as indicated, voltage rating consistent with circuit voltage.
- B. Motor Branch Circuits: Class RK5 time delay.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses in fusible devices as indicated. Arrange fuses so that fuse ratings are readable without removing fuse.
- B. When fused OCPDs in distribution equipment are indicated utilize the classes shown below unless otherwise specified. Since the fuse sizes were selected based upon generic motor ratings, Installer shall select fuse sizes for motors based upon the nameplate information: 115% of FLA for general service motors and 125% for 1.15 service factor motors. Special motors shall be sized according to manufacturer's written instructions.

3.2 IDENTIFICATION

- A. Install typewritten labels on the inside door of each fused switch to indicate fuse replacement information.

END OF SECTION 16475

SECTION 16476 - DISCONNECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Service disconnects.
 - 2. Feeder and equipment disconnects.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 16 Section "Fuses."

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for switches and accessories specified in this Section.
- C. Descriptive data and time-current curves for protective devices and let-through current curves for those devices with current-limiting characteristics. Include coordination charts and tables, and related data.
- D. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.
- E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.
- F. Field test reports indicating and interpreting test results.
- G. Maintenance data for tripping devices to include in the "Operating and Maintenance Manual" specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.

- C. Single-Source Responsibility: All enclosed switches shall be the product of a single manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide enclosed switches by one of the following:
 - 1. Fusible Switches:
 - a. Cutler-Hammer Products; Eaton Corp.
 - b. Electrical Distribution and Control; General Electric Co.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D Co.

2.2 ENCLOSED SWITCHES

- A. Enclosed Nonfusible Switch: NEMA KS 1, Type HD, handle lockable with 2 padlocks.
- B. Fusible Switch, 800 Amperes and Smaller: NEMA KS 1, Type HD, rejection clips to accommodate specified fuses, built-in fuse pullers arranged to facilitate fuse removal, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position.
- C. Enclosure: NEMA KS 1, Type 1, unless specified or required otherwise to meet environmental conditions of installed location.
 - 1. Outdoor Locations: Type 3R.
 - 2. Other Wet or Damp Indoor Locations: Type 4.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosed switches in locations as indicated, according to manufacturer's written instructions.
- B. Install enclosed switches level and plumb.
- C. Install wiring between enclosed switches and control/indication devices.
- D. Connect enclosed switches and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.2 IDENTIFICATION

- A. Identify components in accordance with Division 16 Section "Electrical Identification." In addition, if fuses are installed, provide a sign for each switch stating:

REPLACE WITH CURRENT LIMITING FUSES ONLY.
CATALOG NUMBER: (fuse cat. no.)

3.3 FIELD QUALITY CONTROL

- A. Testing: After installing enclosed switches and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.5 for enclosed switches. Certify compliance with test parameters.
- B. Correct malfunctioning units at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

3.4 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

3.5 DEMONSTRATION

- A. Review data in the "Operating and Maintenance Manual." Refer to Division 1 Section "Project Closeout."
- B. Schedule training with Owner through the Architect with at least 7 days' advance notice.

END OF SECTION 16476

SECTION 16481 - MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes ac motor-control devices rated 600 V and less that are supplied as enclosed units.
- B. Related Sections include the following:
 - 1. Division 16 Section "Electrical Identification" for labeling materials.

1.3 SUBMITTALS

- A. Product Data: For products specified in this Section. Include dimensions, ratings, and data on features and components.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- C. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents. Measure motor amperage for each motor. Include in record drawings actual amperage, motor horsepower, full load amps, and service factor.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.
- B. Comply with NFPA 70.
- C. Comply with the following:
 - 1. ANSI/NEMA ICS 6 "Enclosures for Industrial Controls and Systems"
 - 2. NEMA ICS 2 "Industrial Control Devices, Controllers, and Assemblies.
 - 3. ANSI/UL-508 "Standard for Electric Industrial Control Equipment".
- D. Listing and Labeling: Provide motor controllers specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
 - a. Underwriters Laboratory
 - b. ETL Testing Laboratories, Inc.

1.5 COORDINATION

- A. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.
- B. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers of Manual and Magnetic Motor Controllers: Subject to compliance with requirements, provide products by one of the following:
 1. Allen-Bradley Co.; Industrial Control Group.
 2. Eaton Corp.; Westinghouse & Cutler-Hammer Products.
 3. General Electric Co.; Electrical Distribution & Control Div.
 4. Siemens Energy & Automation, Inc.
 5. Square D Co.

2.2 MANUAL MOTOR CONTROLLERS

- A. Description: NEMA ICS 2, general purpose, Class A with toggle action and overload element.

2.3 ENCLOSURES

- A. Manual: Flush or surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to meet environmental conditions at installed location. Provide external operating handle and a safety interlock to prevent the door from opening when the unit is in operation.
 1. Outdoor Locations: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.
- C. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.

3.2 INSTALLATION

- A. Install independently mounted motor-control devices according to manufacturer's written instructions.
- B. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.
- C. For control equipment at walls, bolt units to wall.

3.3 IDENTIFICATION

- A. Identify motor-control components and control wiring according to Division 16 Section "Electrical Identification."

3.4 CONNECTIONS

- A. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Testing: After installing motor controllers and after electrical circuitry has been energized, check for proper rotation of all motors and equipment and demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
 - 2. Remove and replace malfunctioning units with new units, and retest.

3.6 CLEANING

- A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

END OF SECTION 16481

SECTION 16515 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Division 16 Basic Materials and Methods Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes interior lighting fixtures, lamps, ballasts, emergency lighting units, and accessories.
- B. Related Sections: The following Division 16 Sections contain requirements that relate to this Section:
 - 1. "Lighting Control Equipment" for modular dimmers, occupancy sensors, and power relays.
- C. Extent of interior lighting fixture work is indicated by drawings and schedules. Provide lighting fixtures for every lighting outlet shown on the accompanying drawings. Where a fixture type designation may have been omitted from the plans, or is unclear to bidder, it shall be the responsibility of the bidder to contact the engineer in writing prior to the bid opening and determine which fixture type is intended at the location in question. If the bidder fails to comply with this requirement, he shall furnish and install fixtures as instructed by the Architect/Engineer without additional cost to the owner. No allowance will be made on behalf of the bidder who fails to comply with this requirement.

1.3 DEFINITIONS

- A. Emergency Lighting Unit: A fixture with integral emergency battery power supply and the means for controlling and charging the battery. They are also known as an emergency light set. Emergency units are available with integral lamps and may have remote lamps if shown.
- B. Fixture: A complete lighting unit, exit sign, or emergency lighting unit. Fixtures include lamps and parts required to distribute the light, position and protect lamps, and connect lamps to the power supply. Internal battery powered exit signs and emergency lighting units also include a battery and the means for controlling and recharging the battery. Emergency lighting units are available with and without integral lamp heads and lamps.
- C. Luminaire: Fixture.

- D. Average Life: The time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data describing fixtures, lamps, ballasts, and emergency lighting units required. Arrange product data for fixtures in order of fixture designation. Include data on features and accessories and the following information:
 - 1. Outline drawings of fixtures indicating dimensions and principal features.
- 2. Electrical ratings and photometric data with specified lamps and certified results of laboratory tests.
 - 3. Data on batteries and chargers of emergency lighting units.
 - 4. Data on ballasts for fluorescent and HID fixtures.
- C. Maintenance data for products for inclusion in Operating and Maintenance Manual specified in Division 1.
- D. Product certifications signed by manufacturers of lighting fixtures certifying that their fixtures comply with specified requirements.
- E. Shop drawings from manufactures detailing nonstandard fixtures and indicating dimensions, weights, methods of field assembly, components, features, and accessories.
- F. A statement shall accompany the lighting fixture submittals indicating that the Installer has complied with the following:
 - 1. Before ordering the fixtures and accessories compare each fixture type with the mounting structure to determine if they are congruous, and whether the mounting accessories are appropriate and complete. If the fixtures are not compatible, contact the Architect/Engineer in writing and under his direction change the fixture type or obtain the proper accessories to make the fixture fit the conditions. Bear all costs arising from the installation of any fixture which conflicts with the mounting condition.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Comply with applicable requirements of NEMA Standard Publications LE 1 and LE 2 pertaining to lighting equipment.
- C. Comply with ANSI 132.1 pertaining to interior lighting fixtures.

- D. Listing and Labeling: Provide fixtures and emergency lighting units that are listed and labeled for their indicated use on the Project.

1.Special Listing and Labeling: Provide fixtures for use in damp or wet locations, underwater, and recessed in combustible construction specifically listed and labeled for such use. Provide fixtures for use in hazardous (classified) locations that are listed and labeled for the specific hazard.

- 2. The terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

3.Listing and Labeling Agency Qualification: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

- E. Manufacturers Qualifications: Firms experienced in manufacturing fixtures that are similar to those indicated for this Project and that have a record of successful performance for a period of 5 years minimum.

- F. Coordination of Fixtures With Ceiling: Coordinate fixtures mounting hardware and trim with the ceiling system.

1.6 WARRANTY

- A. Special Project Warranty: Submit a warranty, mutually executed by manufacturer and the Installer, agreeing to replace rechargeable system batteries that fail in materials or workmanship within the special project warranty period specified below. This warranty is in addition to, and not a limitation of, other rights and remedies the Owner may have under the Contract Documents.

- 1. Special Project Warranty Period: 10 years, beginning on the date of Substantial Completion. A full warranty shall apply for the first year of the period, and a prorata warranty for the last 9 years.

1.7 EXTRA MATERIALS

- A. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to the Owner.

- 1. Lamps: 10 lamps for each 100 of each type and rating installed. Furnish at least 1 of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Fixtures: as indicated on the fixture schedule for the type shown.
2. Lamps: specialty lamps are indicated in the fixture schedule, otherwise as shown below.
 - a. General Electric Co. Lighting.
 - b. Osram Sylvania Lighting.
 - c. Philips Lighting Co.
 - d. Thorn Lighting Ltd.
3. Ballasts and Transformers:
 - a. Electronic Ballasts
 - 1) Motorola Lighting Products
 - 2) Magnetek
 - 3) Advance Transformer
 - 4) Sylvania

2.2 FIXTURES, GENERAL

- A. Comply with the requirements specified in the Articles herein and lighting fixture schedule.

2.3 FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs and sharp corners and edges.
- B. Sheet Metal Components: Steel, except as indicated. Components are formed and supported to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating and free from light leakage under operating conditions. Arrange to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in the operating position.
- D. Reflecting Surfaces: Minimum reflectances as follows, except as otherwise indicated:
 1. White Surfaces: 90 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
 4. Laminated Silver Metallized Film: 92 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass except as indicated.

1. Plastic: Highly resistance to yellowing and other changes due to aging, exposure to heat and UV radiation.
 2. Lens Thickness: 0.125 inches, minimum.
- F. Fixtures shown in the schedule to be recessed shall be complete with plaster frames, mounting yokes, rod hangers to furnish support from the structure above and/or any other accessories required to fit the fixture to the ceiling construction. Recessed lay-in type shall have four (4) tee bar earthquake mounting clips.
- G. Fixtures scheduled to be pendant mounted shall be complete with supports above the ceiling, stems and canopies, swivel aligners and/or other accessories necessary to suspend the fixtures at the specified height above the floor or as instructed by Architect/Engineer. Should adjustment be required, the Installer shall comply without additional cost. Chain may be used where noted on the drawings.
- H. Fluorescent fixtures in continuous rows shall be supplied with all fixture couplings, chase nipples, and/or other accessories recommended by the manufacturer for continuous row installation.
- I. All recessed fixtures shall be installed with 6 feet of flexible conduit and THHN fixture wire to an extension outlet box.
- J. Surface mounted light fixtures shall have spacers provided for ballast cooling where recommended by manufacturer.
- K. Pendant fixtures, general; provide 1 set of pendant stems of the length indicated, and provide one additional set of another length, with installation, at no additional charge, if requested to do so by the Architect/Engineer.

2.4 SUSPENDED FIXTURE SUPPORT COMPONENTS

- A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.
- B. Rod Hangers: 3/16-inch diameter cadmium plated, threaded steel rod.
- C. Chain Hanger: Not allowed.

2.5 FLUORESCENT FIXTURES

- A. Fixtures: Conform to UL 1570, "Fluorescent Lighting Fixtures."
- B. Electronic Non-Dimming Ballasts: Solid-state, non-hybrid, rapid start lamp operation only, full-light (>94%) output, energy-saving type compatible with energy-saving lamps. Lamps shall be driven by semiconductors. Conform to FCC Regulations Part 15, Subpart J, for electromagnetic interference. Conform to IEEE C62.41, "Guide for Surge Voltages in Low-Voltage AC Power Circuits," Category A, for resistance to voltage surges

for normal and common modes. Parallel lamp wiring, rapid start technique, unless noted otherwise.

1. Minimum Power Factor: 90 percent.
2. Minimum Ballast Factor: 88 percent, ANSI Conditions.
3. Minimum Operating Frequency: 22,000 Hz.
4. Third Harmonic Content of Ballast Current: Less than 10 percent.
5. Total Harmonic Content of Ballast Current: Less than 23 percent.
6. Average Input: The following is the average required wattage when tested according to ANSI C82.2, "Fluorescent Lamp Ballasts, Methods of Measurement." Rating with energy saving T12 lamps, or standard T8 lamps.
 - a. 114 or less watts when operating four F32T8 lamp.
 - b. 91 or less watts when operating three F32T8 lamps.
 - c. 62 or less watts when operating two F32T8 lamps.
 - d. 39 or less watts when operating one F32T8 lamp.

2.6 INCANDESCENT FIXTURES

- A. Conform to UL 1571, "Incandescent Lighting Fixtures."

2.7 EXIT SIGNS

- A. Conform to UL 924, "Emergency Lighting and Power Equipment," and the following:
 1. Sign Colors: Conform to local code.
 2. Minimum Height of Letters: Conform to local code.
 3. Arrows: Include as indicated.
 4. Lamp(s) for AC Operation: 1 per face electroluminescent, 70,000 hours warranted life while exceeding NFPA requirements, for connection to 120/277 volt source.

2.8 LAMPS

- A. Conform to ANSI Standards, C78 series applicable to each type of lamp. Comply with section 2.1.A.2.
- B. Conform to EPA rules. Fluorescent, HID and other lamps containing mercury shall pass the current TCLP (Toxicity Characteristic Leaching Procedure) test, where products are available.

2.9 FINISH

- A. Visible reflectors and trims shall be as indicated on the fixture schedule. Care shall be taken to prevent finishes from scratches or dirt during installation.

- B. Other Steel Parts: Manufacturer's standard finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, and defects. Remove fixtures showing evidence of corrosion during project warranty period and replace with new fixtures.
- C. Other Parts: Manufacturer's standard finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Setting and Securing: Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer's printed instructions and approved shop drawings, in compliance with applicable requirements of the NEC, NECA's "Standards of Installation", NEMA Standards and recognized industry standards to ensure lighting fixtures are properly installed.
- B. Support For Recessed and Semirecessed Fixtures: Install fixture system support rods or wires at a minimum of four rods or wires per fixture located not more than 6 inches from fixture corners.
 - 1. Fixtures of Sizes Less Than Ceiling Grid: Center in the acoustical panel. Support fixtures independently with at least two 3/4-inch metal channels spanning and secured to the ceiling tees.
 - 2. Install support clips for recessed fixtures, securely fastened to ceiling grid members, at or near each fixture corners.
- C. Support for Suspended Fixtures: Brace pendants and rods that are 4-feet long or longer to limit swinging. Support stem mounted single-unit suspended fluorescent fixtures with twin-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of chassis, including one at each end.
- D. Lamping: Lamp units according to manufacturer's instructions and fixture schedule.
- E. Wiring: Connect fixtures with wire sufficient for the temperature ratings as specified for the fixtures supplied. Use connection devices with coordinated temperature rating. Do not use intermediate splices, run wire from panel or required device.
- F. Coordinate with other electrical work as appropriate to properly interface installation of interior lighting fixtures with other work.
- G. Cooperate with ceiling tile Installer to obtain symmetrical arrangement of fixtures in acoustic tile ceiling. Provide additional supporting members for fixtures in lay-in acoustical ceilings. At least two (2) supporting members are required per fixture if manufactured in one (1) channel.
- H. Fixtures shall not be installed until the first coat of paint has been applied, where practicable. Nicks and scratches on the exposed surfaces of the fixture shall be

repaired. All single outlets shall be symmetrically located in each room. Where two or more outlets occur, they shall be spaced uniformly in straight lines with each other.

- I. Fasten fixtures securely to indicated structural support and check to ensure that solid pendant fixtures are plumb.
- J. Provide tight equipment grounding connections for each interior lighting fixture installation where indicated.

3.2 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Give advance notice of dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests: Verify normal operation of each fixture after fixtures have been installed and circuits have been energized with normal power source. Interrupt electrical energy to demonstrate proper operation of emergency lighting installation.
- E. Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.3 ADJUSTING AND CLEANING

- A. Clean fixtures upon completion of installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities and direction/shielding.
- C. Protect installed and uninstalled fixtures from damage or dirt during construction. Remove covers after completion of project. Clean fixtures upon completion of construction.
- D. Replace defective and burned out lamps for a period of two months following the time of Substantial Completion.
- E. At the time of Substantial Completion, replace lamps in interior lighting fixtures which are observed to be noticeably dimmed after Installers use and testing, as judged by Architect/Engineer.

END OF SECTION 16515

SECTION 16721 - FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements of the following Division 16 Sections apply to this Section:
 - 1. "Basic Electrical Requirements."
 - 2. "Basic Electrical Materials and Methods."

1.2 SUMMARY

- A. This Section includes an addition to an existing fire alarm system, including manual stations, detectors, signal equipment, controls, and devices.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 15 Section "Fire Protection" for water-flow, pressure, or tamper switches connected to fire alarm system.
 - 2. Division 15 Section "Electric Control Systems" for duct smoke detectors.

1.3 DEFINITIONS

- A. Alarm-Initiating Device: A manual station, smoke detector, heat detector, flame detector, or sprinkler water-flow switch.
- B. Alarm Signal: Signifies a state of emergency requiring immediate action. Pertains to signals such as the operation of a manual station and the operation of a sprinkler system flow switch.
- C. Class A Wiring: Circuits arranged and electrically supervised so a single break or single ground fault condition will be indicated by a trouble signal at the fire alarm control panel (FACP) and the circuit will continue to be capable of operation for its intended service in the faulted condition no matter where the break or ground fault condition occurs.
- D. Class B Wiring: Circuits electrically supervised such that a single break or a single ground fault condition will be indicated by a trouble signal at the FACP no matter where the break or ground fault condition occurs.
- E. Hard-Wired System: Alarm, supervisory, and initiating devices directly connected, through individual dedicated conductors, to a central control panel without the use of multiplexing circuits or devices.
- F. Multiplex System: One using signaling method characterized by the simultaneous or sequential transmission, or both, and the reception of multiple signals in a communication channel, including means for positively identifying each signal.
- G. Supervisory Signal: Indicates abnormal status or need for action regarding fire suppression or other protective system.

- H. Trouble Signal: Indicates that a fault, such as an open circuit or ground, has occurred in the system.
- I. Zone: Initiating device or combination of devices connected to a single alarm-initiating device circuit.

1.4 SYSTEM DESCRIPTION

- A. General: Addition to a complete, zoned, non-coded, addressable, microprocessor-based fire detection and alarm system with manual and automatic alarm initiation, analog addressable smoke detectors, and automatic alarm verification for alarms initiated by certain smoke detector zones as indicated.
- B. Signal Transmission: Multiplex signal transmission dedicated to fire alarm service only.
- C. Audible Alarm Indication: By sounding of horns and bells.
- D. System connections for alarm-initiation and alarm-indicating circuits: Class A wiring.
- E. Functional Description: The following are required system functions and operating features:
 - 1. Priority of Signals: Accomplish automatic response functions by the first zone initiated. Alarm functions resulting from initiation by the first zone are not altered by subsequent alarms. The highest priority is an alarm signal. Supervisory and trouble signals have second- and third-level priority. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all alarm signals regardless of priority or order received.
 - 2. Noninterfering: Zone, power, wire, and supervise the system so a signal on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACP after the initiating device or devices are restored to normal. Systems that require the use of batteries or battery backup for the programming function are not acceptable.
 - 3. Resound capabilities: Provide resound capabilities.
 - 4. Signal Initiation: The manual or automatic operation of an alarm-initiating or supervisory-operating device causes the FACP to transmit an appropriate signal including:
 - a. General alarm.
 - b. Smoke detector alarm.
 - c. Valve tamper supervisory.
 - d. Door release.
 - e. Elevator recall.
 - f. Elevator shutdown.
 - g. System trouble.
 - h. Fan shutdown.
 - 5. Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service transmitter using listed and approved equipment.
 - 6. Silencing at FACP: Switches provide capability for acknowledgment of alarm; supervisory, trouble, and other specified signals at the FACP; and capability to silence the local audible signal and light a light-emitting diode (LED). Subsequent zone alarms cause the audible signal to sound again until silenced in turn by

- switch operation. Restoration to normal of alarm, supervisory, and trouble conditions extinguish the associated LED and cause the audible signal to sound again until the restoration is acknowledged by switch operation.
7. Loss of primary power at the FACP sounds trouble signal at the FACP and indicates at the FACP when the system is operating on an alternate power supply.
 8. Annunciation: Manual and automatic operation of alarm- and supervisory-initiating devices is annunciated both on the FACP and on the annunciator, indicating the location and type device.
- 9.FACP Alphanumeric Display: Displays plain-language description of alarms, trouble signals, supervisory signals, monitoring actions, system and component status, and system commands.
10. General Alarm: A system general alarm includes:
 - a. Indicating the general alarm condition at the FACP and the annunciator.
 - b. Identifying the device that is the source of the alarm (or its zone) at the FACP and the annunciator.
 - c. Initiating audible and visible alarm signals throughout the building.
 - d. Initiating elevators' automatic recall operation.
 - e. Closing fire and smoke doors normally held open by magnetic door holders.
 - f. Stopping supply and return fans serving zone where alarm is initiated.
 - g. Closing smoke dampers on system serving zone where alarm is initiated.
 - h. Unlocking designated doors.
 - i. Initiating transmission of alarm signal to remote central station.
 11. Manual station alarm operation initiates a general alarm.
 12. Water-flow alarm switch operation:
 - a. Initiates a general alarm.
 - b. Causes flashing of the device location indicating lamp of the device that has operated.
 13. Smoke detection initiates a general alarm.
 14. Sprinkler valve tamper switch operation causes or initiates the following:
 - a. A supervisory audible and visible "valve tamper" signal indication at FACP and annunciator.
 - b. The location-indicating light to flash for the device that has operated.
 - c. Transmission of supervisory signal to remote central station.
 15. Remote Detector Sensitivity Adjustment: Manipulation of controls at the FACP causes the selection of specific addressable smoke detectors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings. The same controls can be used to program repetitive, scheduled, automated changes in sensitivity of specific detectors. Sensitivity adjustments and sensitivity adjustment schedule changes are recorded by the system printer.

1.5 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.
- B. Product variations: The drawings indicate wiring and devices engineered from a single manufacturers equipment. Consideration was given to known variations of different

manufacturers, but all variations and dimensions may not be accounted for. Due to this, each manufacturer shall carefully review the drawings and indicated to the Installer on the shop drawings complete installation requirements. Final shop drawings shall be on Mylar with backup disks in AutoCad 2000.

- C. Product data for system components. Include dimensioned plans and elevations showing minimum clearances and installed features and devices. Include list of materials and UL listing data.
- D. Wiring diagrams from manufacturer differentiating between factory- and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Indicate components for both field and factory wiring.
- E. System operation description covering this specific Project including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
- F. Calculations for battery capacity for both alarm and supervisory modes.
- G. Operating instructions for mounting at the FACP.
- H. Operation and maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1. Include data for each type product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.
- I. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.
- J. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of annotated Contract Drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, submit them for review. Make resubmissions if required to make clarifications or revisions to obtain approval.
- K. Record of field tests of system.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A factory-authorized Installer is to perform the Work of this Section.
- B. Compliance With Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authority having jurisdiction.
- C. Comply with NFPA 70, "National Electrical Code."
- D. NFPA Compliance: Provide fire alarm and detection systems conforming to the requirements of the following publications:
 - 1. NFPA 72, "National Fire Alarm Code."
- E. UL Listing: Provide systems and equipment that are UL listed and labeled.

1. Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- F. FM Compliance: Provide fire alarm systems and components that are FM-approved.
- G. Single-Source Responsibility: Obtain fire alarm components from a single source who assumes responsibility for compatibility for system components. Only products which comply with the installed system's UL Listing shall be connected to the system.
- H. Warranty: Provide a three year warranty on all equipment, wiring, and labor.

1.7 EXTRA MATERIALS

- A. General: Furnish extra materials, matching products installed (as described below), packaging with protective covering for storage, and identifying with labels clearly describing contents.
- B. Glass Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.
- C. Lamps for Remote Indicating Lamp Units: Furnish quantity equal to 10 percent of the number of units installed, but not less than one.
- D. Lamps for Strobe Units: Furnish quantity equal to 10 percent of the number of units installed, but not less than one.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. FCI (Nelson Fire is the only approved installer).

2.2 MANUAL PULL STATIONS

- A. Description: Double-action type, fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color. Stations requiring the breaking of a glass panel are not acceptable. Stations requiring the breaking of a concealed glass rod may be provided.
- B. Station Reset: Key- or wrench-operated, double-pole, double-throw, switch-rated for the voltage and current at which it operates. Stations have screw terminals for connections.

2.3 SMOKE DETECTORS

- A. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
 1. Factory Nameplate: Serial number and type identification.
 2. Operating Voltage: 24-V D.C., nominal.
 3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

4. Plug-In Arrangement: Detector and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. The plug connection requires no springs for secure mounting and contact maintenance. Terminals in the fixed base accept building wiring.
5. Visual Indicator: Connected to indicate detector has operated.
6. Addressability: Detectors include a communication transmitter and receiver having a unique identification and capability for status reporting to the FACP.
7. Remote Controllability: Individually monitor detectors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP.

B. Photoelectric Smoke Detectors: Include the following features and characteristics:

1. Detector Sensitivity: Between 2.5- and 3.5-percent-per-foot smoke obscuration when tested according to UL 268.
2. Sensor: An infrared detector light source with matching silicon cell receiver.

2.4 OTHER DETECTORS

- A. Thermal Detector: Combination fixed-temperature and rate-of-rise unit with mounting plate arranged for outlet box mounting; 135-deg F fixed-temperature setting except 175 degree for boiler rooms and other rooms with ambient temperatures over 110 degree F.
- B. Addressable Thermal Detector: Rate-compensated/fixed-temperature type with plug-in base and alarm indication lamp. Detectors have a communication transmitter and receiver with unique identification and capability for status-reporting to the FACP.

2.5 ALARM-INDICATING DEVICES

- A. General: Equip alarm-indicating devices for mounting as indicated. Provide terminal blocks for system connections.
- B. Addressable Interface Units: Arrange to monitor one or more system components that are not otherwise equipped for multiplex communication. Units transmit identification and status to the FACP using a communication transmitter and receiver with unique identification and capability for status-reporting to the FACP.
- C. Fire Alarm Horns: Electric-vibrating polarized type, operating on 24-V d.C., with provision for housing the operating mechanism behind a grille. Horns produce a sound pressure level of 85 dB, measured 10 feet from the source.
- D. Visual Alarm Devices: Dual-voltage (120-V A.C. or 24-V D.C.) strobe lights with clear polycarbonate lens and xenon flash tube. Mount lenses on an aluminum face plate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
 1. Lamps have a minimum peak intensity of 75 candela. Strobe leads are factory-connected to screw terminals.
 2. Combination devices consist of factory-combined, audible and visual alarm units in a single mounting assembly.

2.6 DEVICE LOCATION-INDICATING LIGHTS

- A. Description: A system-voltage-indicating light denotes the location of each sprinkler water flow switch and valve tamper switch. A red-laminated, phenolic resin identification plate at the indicating light bears, in engraved white letters, the room numbers of protected spaces downstream from the water-flow switch, or the room number where the valve is located.

2.7 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Electromagnet operates from a 24 VDC source, and requires no more than 3 watts to develop 25 lbs. holding force.
- B. Material and Finish: Match door hardware.

2.8 FIRE ALARM CONTROL PANEL (FACP)

- A. General: Comply with UL 864, "Control Units for Fire-Protective Signaling Systems."
- B. Cabinet: Lockable steel enclosure. Arrange panel so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control panel, provide exactly matching modular unit enclosures. Accommodate all components and allow ample gutter space for interconnection of panels as well as field wiring. Identify each enclosure by an engraved, red-laminated, phenolic resin nameplate. Lettering on the enclosure nameplate shall not be less than 1-inch high. Identify individual components and modules within the cabinets with permanent labels.
- C. Systems: Alarm and supervisory systems are separate and independent in the FACP. The alarm-initiating zone boards in the FACP consist of plug-in cards. Construction requiring removal of field wiring for module replacement is not acceptable.
- D. Control Modules: Types and capacities required to perform all functions of the fire alarm systems. Local, visible, and audible signals notify of alarm, supervisory, and trouble conditions. Each type of audible alarm has a distinctly different sound.
- E. Zones: Provide for all alarm and supervisory zones indicated.
- F. Indicating Lights: Provide individual LED devices for each zone. An LED test switch for each FACP section illuminates all LED devices on that section of the control panel. Manual toggle test switches or push test-buttons do not require a key to operate. Alarm and supervisory signals light a red LED of the associated zone. Trouble signals light an amber LED for the associated zone.
- G. Resetting: Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm or trouble condition still exists.
- H. Alphanumeric Display and System Controls: Arrange to provide the basic interface between human operator at FACP and addressable system components, including annunciation, supervision, and control. A display with a minimum of 32 characters displays alarm, supervisory, and component status messages and indicates control commands to be entered into the system for control of smoke detector sensitivity and other parameters. Arrange keypad for use in entering and executing control commands.
- I. Instructions: Printed or typewritten instruction card mounted behind a lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a location observable from the FACP. Include interpretation and appropriate response for displays and signals, and briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.9 EMERGENCY POWER SUPPLY

- A. General: Components include valve-regulated, recombinant lead acid battery, charger, and an automatic transfer switch. Battery nominal life expectancy is 10 years minimum.

- B. Battery capacity is adequate to operate the complete alarm system in normal or supervisory (nonalarm) mode for a period of 24 hours. At the end of this period, the battery has sufficient capacity to operate the system, including alarm-indicating devices in either alarm or supervisory mode for a period of 15 minutes. Provide, in addition, 25% spare capacity.
 - 1. Magnetic door holders are not served by emergency power. Magnetic door holders are released when normal power fails.
- C. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining the batteries at full charge. In the event batteries are fully discharged, the charger recharges them fully within four hours. Charger output is supervised as part of system power supply supervision.
- D. Automatic transfer switch transfers the load to the battery without loss of signals or status indications when normal power fails.

2.10 WIRE

- A. Line-Voltage and Low-Voltage Circuits: Solid copper conductors with 600 V-rated insulation installed in raceway.

2.11 TAGS

- A. Tags For Identifying Tested Components: Comply with NFPA 72.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install system according to NFPA Standards referenced in Parts 1 and 2 of this Section.
- B. Fire Alarm Power Supply Disconnect: Paint red and label "FIRE ALARM." Provide with lockable handle or cover.

3.2 EQUIPMENT INSTALLATION

- A. Existing Fire Alarm Equipment: Maintain fully operational until the new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until the new equipment is accepted. Remove tags from new equipment when put into service and tag existing fire alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of the new fire alarm system, remove existing, disconnected fire alarm equipment and restore damaged surfaces. Package operational fire alarm and detection equipment that has been removed; deliver to the Owner. Remove from the site and legally dispose of the remainder of the existing material.
- C. Manual Pull Stations: Mount semi-flush in recessed back boxes with operating handles 54 inches above finished floor or as indicated.
- D. Water-Flow Detectors and Valve Supervisory Switches: Connect for each sprinkler valve station required to be supervised.

- E. Smoke Detectors: Install ceiling-mounted detectors not less than 4 inches from a side wall to the near edge. Install detectors located on the wall at least 4 inches but not more than 12 inches below the ceiling. For exposed solid joist construction, mount detectors on the bottoms of the joists. On smooth ceilings, install detectors not over 30 feet apart in any direction. Install detectors no closer than 5 feet from air registers.
- F. Audible Alarm-Indicating Devices: Install not less than 90 inches above the finished floor nor less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille or as indicated. Combine audible and visual alarms at the same location into a single unit.
- G. Visual Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and not less than 80 inches above the finished floor and at least 6 inches below the ceiling.
- H. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.
- I. Fire Alarm Control Panel (FACP): Semi-flush mount with tops of cabinets not more than 6 feet above the finished floor.

3.3 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceway according to Division 16 Section "Raceways." Conceal raceway except in unfinished spaces and as indicated.
- B. Wiring Within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the wiring diagrams of the system. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- C. Cable Taps: Use numbered terminal strips in junction, pull or outlet boxes, cabinets, or equipment enclosures where any circuit tap is made.
- D. System Wiring: For the low-voltage portion of the fire alarm system, install minimum No. 14 AWG conductors and 75-deg C insulation in wet, damp, or dry locations. For line-voltage wiring, install No. 12 AWG size with insulation rated 75 deg C minimum.
- E. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuits wiring and a different color code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visual alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- F. Wiring to Central Station Transmitter: 1-inch conduit between the FACP and the central station transmitter connection as indicated. Install number of conductors and electrical supervision for connecting wiring as required to suit central-station monitoring function. Final connections to terminals in central station transmitter are made under another contract.

3.4 GROUNDING

- A. Ground equipment and conductor and cable shields. For audio circuits, minimize to the greatest extent possible ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.
- B. Pretesting: Upon completing installation of the system, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
- C. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.
- D. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.
- E. Prerequisites for fire alarm final punchlist:
 - 1. Complete system must be put on battery power no less than 24 hours, or longer as specified, prior to final test by in no case less than 24 hours.
 - 2. Provide two-way radios, smoke as recommended by the manufacturer and a hair dryer (or other means to set off heat detectors and resistor to test ground faults.
 - 3. Test each detector. Test each zone by opening loop and by ground fault.
 - 4. All Fire Alarm system junction or pull boxes shall be identified with zone number and red paint.
 - 5. Fan shut down, sprinkler flow and tamper switches, door closers and all other devices shall be operational.
- F. Minimum System Tests: Test the system according to the procedures outlined in NFPA. Minimum required tests are as follows:
 - 1. Verify the absence of unwanted voltages between circuit conductors and ground.
 - 2. Megger test all conductors other than those intentionally and permanently grounded with electronic components disconnected. Test for resistance to ground. Report readings less than 1-megohm for evaluation.
 - 3. Test all conductors for short circuits utilizing an insulation-testing device.
 - 4. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.
 - 5. Verify the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
 - 6. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of the initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
 - 7. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
- 8. Test the system for all specified functions according to the manufacturer's operating and maintenance manual. Systematically initiate specified functional performance items at each station including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item

- under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications.
9. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the period and in the manner specified.
- G. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
 - H. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.
 - I. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

3.6 CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.
- B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.7 DEMONSTRATION

- A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.
 1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.
 2. Schedule training with the Owner at least seven days in advance.

END OF SECTION 16721

SECTION 16915 - LIGHTING CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of lighting controls:
 - 1. Occupancy sensors.

1.3 PRIOR APPROVAL

- A. Prior approval is required for consideration as an approved manufacturer and specific product acceptance. Submit request for approval, consisting of proposed bill of material, catalog data, proof of listing or recognition by an independent testing laboratory, and a written discussion outlining variations with this specification, as soon as possible, but in no case less than 10 working days prior to established bid date.
- B. Failure to follow these procedures shall be cause, within itself, for denial of approval, and may lead to charging the costs of such action to the contractor.

1.4 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.
- B. Product data for products specified in this Section. Include dimensions and data on features and components. Include wiring diagrams and elevation views of front panels of control and indicating devices. Include data on ratings.
- C. Maintenance data for products for inclusion in Operating and Maintenance Manual specified in Division 1.
- D. Record of field tests for tests specified in Part 3 of this Section.
- E. The installer shall provide on site training to familiarize the owner/occupant's staff with proper operation, use, adjustment, maintenance, and troubleshooting for equipment in this section. Provide all necessary operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms experienced in manufacturing and servicing equipment of the types and capacities indicated that have a record of successful

in-service performance. Qualifications include ability to provide training, parts, and emergency repairs at the

- B. Comply with NFPA 70, "National Electrical Code," for components and installation.
- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.

1.6 EXTRA MATERIALS

- A. Furnish extra products as described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to the Owner.
 - 1. Relays: Mechanically held, 1 pole for every 10 poles installed. Furnish at least 1.

1.7 DELIVERY, STORAGE AND HANDLING:

- A. Deliver lighting control equipment and components in factory- fabricated type containers or wrappings, which properly protect equipment from damage.
- B. Store lighting control equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.
- C. Handle lighting control equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Occupancy Sensors:
 - a. Novitas.
 - b. Honeywell, Inc.
 - c. Hubbell, Inc.
 - d. Leviton Electric, Inc.
 - e. Switch-o-Matic.

- f. Sensor-Switch, Inc.
- g. Lightolier Controls, Inc.
- h. Unenco, Inc.
- i. The Watt Watcher, Inc.

2.2 LIGHTING CONTROL EQUIPMENT, GENERAL

- A. Load Compatibility: Lighting control equipment shall be compatible with the controlled loads, particularly with respect to electronic fluorescent ballasts and to minimum loads.

2.3 OCCUPANCY SENSORS

- A. Occupancy Sensors: Sensors shall be UL-listed, passive infra-red type, ultrasonic type, or dual technology type, self contained wall or remote relay wall or ceiling-mounted as indicated. Color shall be as selected by Architect/ Engineer. Areas included in automatic lighting control are shown on the plans. It is the responsibility of the successful vendor to review the requirements as set out herein and in the drawings, and to insure that their products will completely control the loads and cover the areas as shown. A statement of assurance is required from the vendor and installer, stating that this review has been completed. Any discrepancy between the design and the intent must be called to the attention of the Engineer/Architect before bidding. The solution to any ambiguities that arise after bidding is the responsibility of the vendor and installer.
- B. Remote relay unit: Shall consist of one or more sensor heads and one or more power / relay units as indicated.
 - 1. PIR units: Sensing head shall have a selection of 3 pick-up lenses, designed to provide coverage as shown on the drawings, capable of detecting small hand movements anywhere in the area. Coverage shall be in a 360 or 180 degree field of view as shown on the drawings. An adjustable time delay of 15 seconds to 30 minutes to keep lights on for a predetermined period after the last motion detection to prevent false turnoff shall be provided. Fresnel lens shall gather infrared information and concentrate it on the sensor and shall be installed with the lens grooves inward to protect the lens from accumulation of dirt and dust. Pickup system shall filter out the influence of infrared energy in daylight. A switch shall be provided to allow normal operation, bypass on and off modes. Unit shall sense ambient light in the space and automatically turn off the load in the presence of preset amounts of sunlight, and shall be field adjustable. Unit shall be immune to the effects of air conditioning and heating.
 - 2. Ultrasonic units: Sensing head shall provide coverage of up to 2000-square-foot area, as shown on the drawings, detecting small hand movements anywhere in the area. Coverage shall be in a 360 degree field of view. A programmable time delay of 15 seconds to 15 minutes to keep lights on for a period after the last motion detection to prevent false turnoff shall be provided. A crystal controlled transmitter operating at 25Khz shall

be provided, and shall not interfere with any other equipment in the building. Single or dual receivers shall be provided to detect motion in the monitored area. A switch input shall be provided to allow normal operation, bypass on and off modes, use as shown. Unit shall be immune to the effects of air conditioning and heating.

3. Dual Technology units: Unit shall have both PIR and Ultrasonic sensors. These sensor sections shall be separate, and operate either of three operating modes. The first operation mode shall require both technologies be triggered for an On operation and will be held on by either technology, the second operational mode shall allow on operation by a sense from either sensor, but both technologies are required to hold the circuit on. The third mode shall require both sensors sense and hold the operation. Individual PIR and U/S operation shall also be available. Selection of the operational mode shall be a user/field selection. An adjustable time delay of 15 seconds to 15 minutes to keep lights on for a predetermined period after the last motion detection to prevent false turnoff shall be provided. A switch shall be provided to allow normal operation, bypass on and off modes.

IR Section: Sensing head shall have a selection of pick-up lenses, designed to provide coverage as shown on the drawings, detecting small hand movements anywhere in the area. . Fresnel lens shall gather infrared information and concentrate it on the sensor and shall be installed with the lens grooves inward to protect the lens from accumulation of dirt and dust. Pickup system shall filter out the influence of infrared energy in daylight. Unit shall sense ambient light in the space and automatically turn off the load in the presence of preset amounts of sunlight, and shall be field adjustable. Unit shall be immune to the effects of air conditioning and heating.

Ultrasonic section: Sensing section shall provide coverage of up to 2000-square-foot area, as shown on the drawings, detecting small hand movements anywhere in the area. Coverage shall be in a 160 degree field of view. A crystal controlled transmitter operating at 40Khz shall be provided, and shall not interfere with any other equipment in the building. Single receiver shall be provided to detect motion in the monitored area. Unit shall be immune to the effects of air conditioning and heating.

4. Power/relay box; sensors shall receive power from an auxiliary power control station housed in an outlet box in the vicinity and operate a relay in the same box to turn lights on when room is occupied and off when room is unoccupied. Relays shall be rated for a minimum of 20-ampere ballast load or 20-ampere tungsten lamp load.
5. Unit shall sense ambient light in the space and automatically turn off the load in the presence of preset amounts of sunlight. This amount shall be field adjustable.

6. System shall be able to have multiple sensor heads for large areas and/or multiple relays for large loads.
- C. Sensor heads shall be operational and stable in the environment of the location indicated. Normal installations shall operate in temperatures from 120 degrees F to 40 degrees F., low temperature units shall operate down to minus 40 degrees F, weatherproof units shall be sealed from the effects of water and be rated to operate in a temperature from 100 degrees F to minus 20 degrees F., and vandal resistant units shall be as weatherproof units and resistant to vandals.
- D. All power switching devices shall be rated for the type and size load indicated. All units shall be capable of stability controlling electronic ballasts, low voltage loads, and other "sensitive" or "difficult" loads, without dummy loads or other energy inefficient devices or methods. Units shall be immune to the effects of high inrush loads.
- E. All occupancy detectors shall be mounted as shown, with adjustable brackets and other mounting accessories to facilitate proper aiming of the detection devices.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install equipment according to manufacturer's written instructions.
- B. Mount control equipment according to manufacturer's instructions and Division 16 Section "Supporting Devices."
- C. Mounting heights indicated are to bottom of unit for suspended items and to center for wall-mounted ones.
- D. Occupancy Sensors: Unless otherwise indicated, provide one or more remote relay units arranged to control all lights in the room or area. Wire all sensors in the area to the remote relay units so any sensor closes all contacts in the remote relay units. Wire switches ahead of the remote relay units so if the switch is in the off position, the sensors cannot turn on the lights. Provide power to the remote relay unit ahead of the switch for control power.

3.2 CONTROL WIRING INSTALLATION

- A. Install wiring between control devices as specified in Division 16 Section "Wires and Cables" for hard wired connections.
- B. Bundle, train, and support wiring in enclosures.

3.3 FIELD QUALITY CONTROL

A. Visual and Mechanical Inspections: Include the following inspections:

1. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current project drawings.
2. Check tightness of electrical connections with torque wrench calibrated within the previous 6 months. Use manufacturer's recommended torque values.
3. Verify proper protective device settings and fuse types and ratings.
4. Exercise mechanical parts and operable devices according to manufacturer's instructions to verify proper operation.

B. Electrical Tests: Exercise particular caution when testing devices containing solid-state components. Perform the following tests according to manufacturer's instructions:

1. Insulation resistance tests of conducting parts of control components and connecting supply, feeder, and control circuits. Insulation resistance less than 100 megohms is not acceptable.
2. Continuity test of circuits.

3.4 CLEANING AND ADJUSTING

- A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean equipment and devices internally and externally using methods and materials recommended by manufacturers.
- B. Occupancy Adjustments: Upon request within 1 year of date of substantial completion, adjust light levels, make program changes, and adjust sensors and controls.

3.5 DEMONSTRATION

- A. Train Owner's personnel to operate, service, and maintain equipment and system components.

3.6 COMMISSIONING

- A. Operational Tests: Energize systems, program control, and check each controlled area for light levels and lamp and component noise. Adjust components and revise installation as required to correct deficiencies. Operate the system to prove compliance with requirements.
- B. Correct malfunctions and retest until proper operation is achieved.
- C. Special Setup and Commissioning for Occupancy Sensors: Installer shall provide all materials and labor to custom set each sensor to the room and application. This shall occur after all lighting is installed, and initial furnishings installed in room. Adjust each sensor so it is properly activated by persons in the area and/or for perimeter systems also adjust for sunlight entering area. Adjust each sensor so it is not triggered by persons

passing but not entering the area. At the conclusion of this setup, special instruction is required for owners personnel to properly instruct them in operation, adjustment, and maintenance of the system.

END OF SECTION 16915

project manual:

college of nursing fifth floor west renovation

university of utah health sciences

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